The Appraisal of Urban Residential Property:
A Theoretical and Empirical Model of Price Determination

By

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THE APPRAISAL OF URBAN RESIDENTIAL PROPERTY: A THEORETICAL AND EMPIRICAL MODEL OF PRICE DETERMINATION

By

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The inquiry identifies two basic weaknesses of conventional real estate appraisal methodology, namely, inconsistent replication of solutions to valuation problems and the lack of reliable knowledge regarding value relationships. A major contention of the study is that these manifested weaknesses of current appraisal practice are mainly attributable to the compound analogy type of logical argument used to infer the value conclusions.

The purpose of the research is to investigate the nature of price determination in an urban residential housing market which appears to be characterized by a bilateral oligopoly structure. A more specific aim is to examine the plausibility and feasibility of a model which can predict or forecast urban residential sale prices with an acceptable degree of reliability.

The basic appraisal problem is how to explain the level and structure of prices in a defined urban residential market. To guide the inquiry, a theory of urban residential price determination is postulated, and the following main hypothesis is tested:
$Y = f\,(X_i + e \mid S, D, K_i)$, where: Y = expected or probable urban residential sale price; X_i = dimensions of the product, viz., improvements,

site, neighborhood and location; e = error term, assumed to be normally distributed; $| S, D, K_i$ = supply and demand conditions and other market factors, which are assumed to be relatively stable during the period under investigation.

Surrogate variables for the X_i dimensions of the product are postulated as statistical hypotheses, and tested in a classical linear multiple regression model, using least squares estimating techniques. The data for the test was based on a sample of 163 observations from the Gainesville, Florida, housing market. All transactions during the period October, 1970, through March, 1971, were included in the sample if they were in the defined universe. The sample comprised about 70 percent of the transactions during the period.

Many variables were examined as linear and non-linear relations. Based on specified criteria and the use of a combination of selection procedures, a model containing the following variables was selected: quantity of the basic living area, adjusted quantity of the auxiliary components of the improvement, quality of construction index, chronological age of improvement, lot size, extent of site facilities (dummy), neighborhood rating (dummies), distance from the University (quadratic function), distance from the adverse influence of heavy manufacturing (quadratic), and a dummy "area of the city" variable. All relations were statistically significant at the 5 percent level, based on conventional tests.

Due to the collinear nature of the data, the model provides little, if any, reliable knowledge regarding the "true" nature of the relationships affecting price determination and the structure of the market. However the multicollinearity problem may not limit the relia-

bility of the model for prediction purposes. The adjusted coefficient of determination and the standard error of the estimate for the model were 0.95 and $1380 respectively, based on a price range of $15,000 to $45,000. The equation was verified by predicting "extra-sample" observations, testing the stability of the parameter estimators over the sample space (viz., time and area), and testing the assumptions of the model.

The main conclusions of the study are: the results of the model are consistent with the main hypothesis and postulated theory of market behavior; the model is localized and static; the multicollinearity problem needs to be investigated by other research methods and procedures; the high coefficient of determination and low standard error of the estimate tentatively suggest that a predictive regression model of urban residential price determination is plausible, and warrants further investigation.

CHAPTER I

INTRODUCTION

The Problem

An important task of real estate appraisers is to estimate the market value of urban residential property. There is evidence that conventional appraisal methodology does not yield consistent solutions to appraisal problems.[1] The value estimate is not consistently replicated if processed by several appraisers and inconsistent results are frequently obtained by a single appraiser using the three conventional methods of deriving a value conclusion.[2]

The replication problem is manifested in current appraisal practice by the divergent conclusions frequently obtained by the alternative approaches to value, namely, cost, income and market methods. To render a single estimate of value - for which no reliability or confidence index is currently stated - it is necessary to weigh, analyze and synthesize the three individual estimates in order to obtain a final value conclusion.[3] One can scarcely expect consistent appraisal conclusions if the final estimate is based on divergent indications of value via the alternative methods.

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[1] Richard U. Ratcliff, "A Restatement of Appraisal Theory," Wisconsin Commerce Reports, University of Wisconsin at Madison, 1963, Vol. VII, No. 1.

[2] Paul F. Wendt, Real Estate Appraisal: A Critical Analysis of Theory and Practice, New York, 1956.

The problem is also painfully evident in condemnation proceedings where opposing appraisers - testifying as expert witnesses for the property owner and condemning authority - frequently state widely different conclusions as to the value of the property being condemned. Fee appraisers also frequently have substantial errors in their value estimates vis-a-vis actual sale prices. These inconsistencies - between two appraisers valuing the same property and between appraised value and actual sale price - seriously challenge the competence of appraisers and impugn the image of the appraisal fraternity.

A second basic weakness of current appraisal methodology is that it provides unreliable knowledge of the factors influencing residential price determination and the nature of the relationships.[4] Although this problem does not appear to be widely appreciated by the real estate community, the two problems are clearly related: a better understanding of the basic factors and relationships affecting prices should enable appraisers to infer conclusions which can be consistently replicated.

A major contention of this study is that these two problems are attributable to the analytical procedure conventionally used to derive the value conclusion, namely, the compound analogy type of logical argument.

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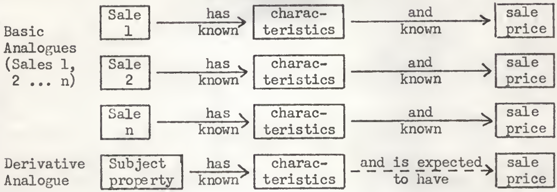
[3] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

[4] Richard U. Ratcliff, "Real Estate Valuation and Highway Condemnation Awards," Wisconsin Commerce Reports, University of Wisconsin at Madison, 1966, Vol. VII, No. 6.

The following diagram illustrates the logical pattern of a compound analogy.[5]



The information contained in the premises, indicated by solid lines, provides the basis for the probable inference, indicated by the broken line. The strength of the argument depends on the number of basic analogues, and the degree and extent of comparability between the basic and derivative analogues. An outstanding feature of current appraisal methodology is that the number of basic analogues is small, frequently as few as three or four;[6] while a well-known characteristic of the real estate market is the great heterogeneity of the product to be appraised.[7] Under these conditions, it is not surprising that inconsistent value conclusions are frequently obtained when the compound analogy is used as the logical argument for the inference.

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[5] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956.

[6] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

[7] Alfred A. Ring, Real Estate Principles and Practices, 6th ed., Englewood Cliffs, N.J., 1967.

Regardless of the form of the logical argument, the fundamental appraisal problem remains the same, namely, how to explain the level and structure of urban residential prices in a market which appears to be characterized by a bilateral oligopoly structure.[8] Since the appraiser does not determine value but merely seeks to measure it, the appraisal process should be a model of the market mechanism to the extent feasible, or at least those variables influencing price variations should be identified and their effects measured. The model must in the final analysis cope with two formidable dimensions of the problem: the indeterminancy of price due to the market structure and the great heterogeneity of the commodity.

In sum, Professors Ratcliff, Wendt and others have seriously questioned the efficacy of real estate appraisal theory and practice. A major contention of the study is that the manifested weaknesses of appraisal practice are attributable to the compound analogy type of logical argument currently used to infer the value conclusion. The existence and significance of the problems dealt with in the inquiry, and the pointed need for basic research in appraisal theory and methodology, have been generally acknowledged.[9]

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[8] George J. Stigler, The Theory of Price, 3d ed., New York, 1966.

[9] See: Edward F. Renshaw, "Scientific Appraisal," National Tax Journal, XI, No. 4. (1958), and William C. Pendleton, Jr., "Statistical Inference in Appraisal and Assessment," The Appraisal Journal, XXXIII (January, 1965).

Purpose of the Research and Hypotheses to Be Tested

The purpose of the research is to investigate the nature of price determination in the urban residential housing market. To guide the inquiry, a theory of urban residential price determination is postulated, based on a priori premises, conventional economic theory and empirical generalizations from experience and observation. Consistent with the theory of market behavior, lesser generalizations and predictive hypotheses are postulated and empirically tested by induction. If the hypotheses are determined to be statistically significant, i.e., the null hypothesis is rejected, then this would be a tentative affirmation of the higher level generalizations and the theory of residential price determination.

A specific aim of the inquiry is pragmatic, namely, to investigate the plausibility and feasibility of a model to predict and forecast urban residential sale prices with an acceptable degree of reliability and effectiveness. Such a model would have important implications for tax assessors and the appraisal fraternity.

The main sources of residential price variations, i.e., the structure of market prices, are expected to be attributable to variations in the magnitude and duration of the expected utility flow to be derived from the consumption of housing, assuming that relatively stable supply and demand conditions prevail. This portion of the model is presumed to be determinate. The indeterminancy of the bargaining process is incorporated into the model as an error term, which is assumed to be a randomly distributed variable.

A major hypothesis to be tested is that:

$$\hat{Y} = f\ (X_1, X_2, X_3, X_4, e \mid S, D, K_i)$$

where:

$\hat{Y}$ = expected or probable urban residential sale price in a specified market in the time period under consideration

X_1 = improvements

X_2 = site

X_3 = neighborhood

X_4 = location

e = error term, which is assumed to be normally distributed with a zero mean and standard deviation

$\mid S, D, K_i$ = given supply and demand conditions and other market factors, i.e., these are assumed to be relatively stable during the short-run, say three months.

Since the preceding factors are higher generalizations not amenable to direct testing, surrogate variables are proposed for testing. A large number of variables are tested as statistical hypotheses in the following classical linear regression model.[10]

$$\hat{Y} = a_o + a_1X_1 + a_2X_2 + \dots + a_nX_n + e$$

where:

$\hat{Y}$ and e = defined as above

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[10] David S. Huang, Regression and Econometric Methods, New York, 1970.

a_i = estimated regression coefficients or parameter estimators

X_i = regressors or predictor variables, including those based on transformed non-linear functions.

The hypotheses and model are tested and verified using conventional statistical methodology.

The Data

The study is based on cross-sectional data from 163 residential transactions within the Gainesville, Florida, corporate area during the period October 1, 1970, to March 31, 1971. All transactions during the period were included in the sample if: improved with a single-family, one-story residential dwelling; sold for between $15,000 and $45,000; zoned Rla, Rlb or Rlc; constructed within the last 30 years; lot size did not exceed 1 acre; exchange appeared to be an "arm's length" transaction conveying fee simple title by warranty deed; and sale price was confirmed.

The limitations on the population of transactions to be sampled were imposed for a number of reasons. In view of the extreme heterogeneity of the data at the excluded upper and lower ranges, many additional variables may need to be examined, or several models required, in order to extend the methodology to the entire residential market. As the purpose of the inquiry is to establish the plausibility of a statistical appraisal model, an intensive and extensive examination of the excluded ranges is left to future research efforts. In spite of the limitations on the scope of the study, the sample included about 70 percent of all the residential sales in the corporate area during the period and should provide a substantive test of the methodology.

Some of the excluded transactions, such as "non-arm's length" transactions (sale between father and son, etc.), warrant exclusion in any appraisal method since they would tend to bias the probability estimate. Statistical models usually assume that the error term is randomly distributed with zero mean and standard deviation. If certain transactions are consistently below the expected sale price, rather than being randomly distributed about the mean, then inclusion of the observations would tend to bias the predictive validity of the model for the population.

The data used in the inquiry was collected from the following sources: tax assessor's data plant, listing agreements, published studies (such as land use analysis, planning unit study, neighborhood analysis, etc.), interviews with owners, and physical inspection of each sale property, neighborhood and location. Much of the data was obtained from the tax assessor's office records, and some data was collected from two sources, i.e., duplicated, in order to check the accuracy of the information. In sum, the data is believed to be highly reliable.

Methods and Procedures

The foundations of real estate valuation and the critical analysis of conventional appraisal methodology are based mainly on deductive methods.[11] Postulates derived from economic theory and empirical generalizations from experience and observation provide the basis for the theory of urban residential price determination. Lesser generalizations and specific hypotheses are deduced from the theory of residential market behavior. The hypotheses are tested by inductive methods.

The analytical procedure and statistical methodology of the study are of particular importance since they represent significant departures from conventional real estate appraisal methodology. It should be noted however that this is not a theoretical study in statistical methodology; rather widely used analytical procedures and accepted statistical techniques are being applied to a new problem, namely, urban residential price determination.[12]

The compound analogy, which is currently the analytical procedure used to process value conclusions by the cost, market and income methods, is generally considered to be a relatively weak form of logical argument.[13] To strengthen the inference, a number of alternatives are available, the number of analogues can be increased and those basic analogues can be chosen which have many similarities and few dissimilarities vis-a-vis the derivative analogue. Or the form of the logical argument may be changed, such as to inductive argument.[14]

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[11] Carlos L. Lastrucci, The Scientific Approach: Basic Principles of the Scientific Method, Cambridge, Mass., 1967.

[12] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

[13] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956.

The inductive argument differs basically from the compound analogy in that the former leads to a generalization or universal conclusion, within a defined population, while the latter infers a singular conclusion. For example in the valuation of residential property, the appraiser - using the compound analogy - infers that the subject property under appraisement will probably sell for "X" dollars since comparable properties 1, 2, 3 and 4 sold for "X" dollars. There is no attempt to draw a generalization regarding the probable sale price of other residential properties not included in the analogy.

On the other hand, the inductive argument seeks to generalize from a sample of observations to all observations in a defined universe. This shift in emphasis from singular to general conclusions is an important one in scientific inquiry.[15] Science is advanced by an accumulation of generalizations about phenomena which have been empirically verified. When confirmed by objective, logical methods, these generalizations in turn provide a basis for further generalizations, which need to be investigated and confirmed, thereby adding to the stock of scientific knowledge.

The parameters of the model are estimated by inductive methods, using regression and variance analyses to identify the association between variables and measure the empirical "fit" of the relationships. These techniques are generally accepted and widely used in economic research.[16] Regression provides a simple, yet powerful, technique for analyzing functional relationships. This method of analysis is especially well suited for the present inquiry since little is known about the nature of the relationships and given the collinear nature of the data.[17]

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[14] Ibid.

[15] Ibid.

The calculations for the statistical analysis were processed on the IBM 360 computer using program ECON[18] and two regression programs from the Biomedical Computer Programs series.[19]

Limitations of the Study

The main limitations of the study relate to the nature, interpretation and application of the predictive model. The model is localized. It is well known that real estate markets are localized due to the nature of the product; thus a new model must be developed for each market.[20] The purpose of this study is to establish the feasibility of a localized model, and to illustrate methods and procedures which may have broad application in the development and utilization of appraisal models in other areas.

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[16] Gene Wunderlich and W.L. Gibson, Jr., "Selection of Analytical Procedures," Land Economics Research, Resources for the Future, Inc., Washington, D.C., 1962.

[17] David S. Huang, Regression and Econometric Methods, New York, 1970.

[18] The original ECON regression program was written by Mr. M.R. Norman of M.I.T. A modified program was made available at the University of Florida by John Kraft and Stanley Warner.

[19] W.J. Dixon, ed., BMD Biomedical Computer Programs, Berkeley,Cal., 1970. Regression programs "BMD 02R", stepwise regression, and "BMD 03R", multiple regression with case combinations, were used in developing the models.

The model is static. Since the model employs only cross-sectional data, it is obvious that the study adds little, if any, knowledge about the nature and stability of the relationships over time. It will be necessary to develop a procedure for controlling and up-dating the model.

The model must be carefully interpreted due to the inter-related nature of the data. The problem of multicollinearity in the data severely limits the specification and interpretation of the model.[21] This will be a problem in any urban residential market. However it is generally acknowledged that, although structural questions can not be meaningfully investigated, the multicollinearity problem may not seriously affect the model for prediction purposes, where due caution is exercised.[22]

The investigation is limited to the residential housing market and even to a specified population within that market. Further research is needed to extend the methodology to the entire residential market, and to investigate the feasibility of applying the procedures and statistical techniques to the appraisal of other classes of real property, such as "income" property.

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[20] Alfred A. Ring, Real Estate Principles and Practices, 6th ed., Englewood Cliffs, N.J., 1967.

[21] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

[22] David S. Huang, Regression and Econometric Methods, New York, 1970.

Review of Empirical Studies

Several empirical studies were conducted in recent years seeking to explain variations in agricultural land values.[23] Although an examination of these studies yielded fruitful insights in method and procedure, they are not considered to be particularly relevant to the present study. This review is limited to those empirical inquiries pertaining to the urban residential housing market.

Emerson

The purpose of Emerson's study was to examine the effect of aircraft nuisance on residential property values.[24] A Cobb-Douglas type function was used to test the impact of selected variables on residential sale price. The coefficient of determination, expressing the ratio of the variance explained to the total variance, for the study was $(R^2=)0.80$.

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[23] For example, see: F.E. Abdel-Badie, An Econometric Analysis of Factors Affecting Land Values in Western Oklahoma, Ph.D. dissertation, Oklahoma State University, 1967. Produced by University Microfilms, Inc., Ann Arbor, Michigan and John Bailey Britney, Time Series Analysis of Factors Affecting the Value of Farm Real Estate, 1911-1959, Ph.D. dissertation, Purdue University, 1964. Produced by University Microfilms, Inc.

[24] Frank C. Emerson, The Determinants of Residential Value with Special Reference to the Effects of Aircraft Nuisance and Other Environmental Features, Ph.D. dissertation, University of Minnesota, 1969. Produced by University Microfilms, Inc.

Although some of the findings are relevant to the present study, the inquiry does not provide a meaningful examination and treatment of the problem identified in this study, which is of course to be expected since the stated objective was to investigate the impact of noise pollution. As contrasted with the present investigation, there are significant differences with regard to: statement of problem, hypothesis to be tested, and research design and methodology.

Harris

The objectives of Harris's inquiry were to develop and apply theories of central land values and residential land values.[25] The results of the first objective are not especially relevant to this study. The theory of residential land values was based on a theory of choice. It was hypothesized that the consumer chooses between four goods: lot size, amenity, leisure, and all other goods. Based on statistical significant surrogate variables tested, Harris concluded that amenity, travel savings, and lot size have a major effect on land values. The study was based on data from tax records and a travel habits survey; regression was the method of analysis.

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[25] Roger N.S. Harris, Determinants of Central Shopping and Residential Land Values, Ph.D. dissertation, North Carolina State of the University of North Carolina at Raleigh, 1965. Produced by University Microfilms, Inc.

Harris's investigation sheds light on the subject of consumer choice, and the regression analysis of amenity in terms of supply and demand contributes to a better understanding of forces influencing urban land values. However the study does not attempt to analyze factors influencing price determination of improved residential properties, which is the task of the present study.

Pendleton

The objective of the study was to examine the impact of highway accessibility on property values.[26] The hypothesis was tested by relating variations in residential sale prices to differences in accessibility characteristics.

The findings of the study are pertinent to the present investigation since this appears to be the first empirical inquiry in which an attempt has been made to explain differences in sale prices of residential properties by statistical method. The variables included in the final equation were: square feet of house, accessibility, square feet of lot, construction material, basement, bathrooms, extras, median income, age of house and style of house.

Pendleton concluded by stating:

> The R^2 of .923 resulting from the best run ... indicates that, even with a small sample and data not specifically collected for statistical analysis, enough variance can be explained to warrant further work. More attention to each variable is needed, additional variables should be included, and more thorough checking for accuracy is called for.[27]

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[26] William C. Pendleton, Jr., The Value of Highway Accessibility, Ph.D. dissertation, The University of Chicago, 1963. Produced by The University of Chicago Library.

[27] Ibid., p. 60.

The present inquiry differs from the Pendleton study with regard to: objectives of the study, theory of residential price determination, and hypotheses tested. An explicit effort has also been made to juxtapose the theory and procedures used in this study with conventional real estate theory and methodology.

Wallace

Wallace's study postulates a theory of urban residential price determination and seeks to "explain" the structure of urban property values.[28] The inquiry is similar in some respects to the present investigation; thus the Wallace study needs to be examined closely.

Contrary to the title, Wallace's study did not develop a clear theory of urban residential price determination. Rather, from a series of economic postulates and premises a main generalization was deduced, namely, that the determinants of utility and value are: use, use alternatives, and location.

The variables tested were: net condition, building class, proximity to commercial activities, proximity to traffic, traffic volume, time distance to campus, area of improvements, and foot frontage. A number of models were tested using assessed value and sale price as the dependent variables. The "best" model, using sale price as the regressand, had an R^2 of 0.546 and a standard error of the estimate of \$6,161, with only 4 of the 9 variables being significant at the 5 percent level.

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[28] William H. Wallace, A Theory of Urban Residential Property Value Determination, With Emphasis upon Alternative Estimating Procedures, Ph.D. dissertation, University of Illinois, 1962. Produced by University Microfilms, Inc.

The main similarities between Wallace's study and the present inquiry are: the statement of the problem and the statistical methodology. Beyond this, there are few similarities. Wallace's model is founded entirely on traditional economic theory, with only one incidental reference being made to appraisal literature. Although economic theory is extensively incorporated in the present study, an explicit attempt is made to relate the inquiry to current appraisal theory and practice.

The Wallace study had, at best, a vague theory of residential price determination, while this study is founded on a concept of price behavior in a market characterized by a bilateral oligopoly structure. The deduced generalizations and specific hypotheses are substantially different - which presumably accounts, at least in part, for the great disparity between the statistical significance of the models in the respective studies.

It is also useful to note that the Wallace study did not discuss the critical problem of multicollinearity in the data, and no attempt was made to test the stability of the parameter estimators, test the assumptions of the model, or to verify the model by appropriate statistical tests. In sum, the study makes some important theoretical, methodological and empirical contributions to an investigation of the problem, but the inquiry has practically no relevance to the appraiser who must cope with the problem, i.e., Wallace's model does not "fit" the data very well and does little to establish the plausibility of a predictive model.

Organization of the Study

Chapter Two discusses the economic concepts of price and value, and reviews the foundations of real estate valuation. The efficacy of conventional appraisal methodology is summarized and critically evaluated in Chapter Three.

A theory of urban residential price determination is postulated, premises and assumption are specified, and a generalized statistical model is developed in Chapter Four. The variables and hypotheses are specified in Chapter Five. A predictive regression equation is selected and the model is tested for stability over the sample space. The results of the equation are interpreted, and maintenance of the model is discussed.

The conclusions of the inquiry are summarized and a synopsis of further research suggested by the investigation is discussed in Chapter Six.

CHAPTER II

FOUNDATIONS OF REAL ESTATE VALUATION

Value and Price

Value is an elusive concept which has been of central concern to economists, and occasionally philosophers, for centuries.[1] Value theory is one of the most basic propositions of economic theory.[2] The notion that an individual can order his wants is fundamental to other economic propositions such as the substitutability of different goods, exchange theory and price theory.[3] Also the postulate that an individual seeks to maximize or "satisfice" his own welfare is predicated on the assumption that wants may be ordered for decision purposes, i.e., this is required if the alternatives are to be rationally evaluated.[4]

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[1] Jacob Oser, The Evolution of Economic Thought, 2d ed., New York, 1970.

[2] Lionel Robbins, An Essay on the Nature and Significance of Economic Science, 2d ed., London, 1935.

[3] F.S.C. Northrop, The Logic of the Sciences and the Humanities, New York, 1947.

[4] Kenneth E. Boulding, Economic Analysis, 4th ed., New York, 1966.

Economic goods, which by definition are scarce, have value because they are wanted by units of society to satisfy particular needs and desires.[5] Thus value is extrinsic, not intrinsic.[6] Without people to express preferences, there would be no individual valuations, and no market valuations. Confusion frequently arises unless a clear distinction is made between individual and market valuations, especially regarding the measurability of value.[7] Individual value is clearly not measurable on a cardinal scale, i.e., 10, 9, 8 ... utils can not be assigned by an individual to an x, y, z ... series of economic goods. However individuals do make valuations, at least ordinally, as this is necessary in order to evaluate alternatives for decision purposes.

While individual valuations are fundamental to any general theory of value, we proceed to market valuations, which are the object of the appraisal process. Exchange ratio, as used in this study, expresses the ratio between two economic goods.[8] Confusion can be minimized by distinguishing between two types of exchange ratios, namely, price and market value. The former is established in an actual transaction and measures the ratio of exchange between a commodity and money, while market value is the ratio of exchange between a commodity and money, based on a valuation process (actual or presumed). Market value, as defined above, is an inference based on expected market behavior, and should, when feasible, be expressed as a conditional probability when valuations are rendered.

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[5] Paul A. Samuelson, Economics: An Introductory Analysis, 7th ed., New York, 1967.

[6] F.S.C. Northrop, The Logic of the Sciences and the Humanities, New York, 1947.

[7] An interesting controversy between Benedetto Croce and Wilfredo Pareto on the measurability of value is discussed in the following treatise on Italian appraisal theory. Guiseppe Medici, Principles of Appraisal, Ames, Iowa, 1953.

[8] Kenneth E. Boulding, Economic Analysis, 4th ed., New York 1966.

A number of writers have emphasized the central role of price statistics in the determination of market value.[9] Since value is extrinsic, not intrinsic, market value is founded on a system of actual exchanges, i.e., price ratios. An economic good is created by the productive process, which gives rise to an original exchange ratio when the good is purchased. The good is amortized or destroyed by indirect (producer good) or direct (consumer good) consumption. An economic good is a stock variable which is related to a flow variable, utility (or income as a surrogate), over time by past, present and future exchange ratios. Price statistics are important determinants of market value. And valuations, to estimate market value, are founded, directly or indirectly, on prices.[10]

Presumably there would be no appraisal problem if the prices, i.e., actual exchange ratios, of all commodities were known at a given moment. But since this is not the case, market value must be estimated for various economic goods. Ideally, the appraiser should seek to forecast the exchange ratio that would have prevailed had an actual transaction occurred for the good in question. The appraiser, in effect, is seeking to simulate the behavior of the market system, i.e., the valuation process provides an estimated exchange ratio because the actual exchange ratio, price, was not determined by the market mechanism. If reliable estimates of market value are to be obtained, then the appraisal process should be a model of the market mechanism, or at least should identify and measure the influence of those variables affecting price determination.

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[9] Ibid.

[10] Guiseppe Medici, Principles of Appraisal, Ames, Iowa, 1953.

Exchange Ratios, Income Flows, Time and Valuation

Market value is founded on past, present and future exchange ratios and income flows.[11] Valuation theory and appraisal methodology acknowledges these time dimensions of the market.[12] The original exchange ratio (purchase price) is related to the current exchange ratio (price or market value) by allowing for depreciation or appreciation during the period, while the future exchange ratio (sale price) or expected income flow is related to the present by discounting for the futurity of the stock and/or flow variables.

The following analysis will illustrate the nature of the valuation process and indicate how identical estimates of market value may be derived, given specified premises, by methods using historical and future time dimensions. The market method is not examined since it can be inferred from the historical cost and future income methods.

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[11] Kenneth E. Boulding, Economic Analysis, 4th ed., New York, 1966.

[12] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

Let: V^C, V^I = estimated market value via the historical cost and future income methods, respectively

V_o, V_t, V_n = V at times o, t, n = purchase, appraisement and sale dates = past, expected present and expected future exchange prices or values

R = Revenue = annuity = stabilized net income[13] = aggregate net income from invested capital

i = market = internal = nominal = effective rate of interest[14]

Case 1 Valuation premises: R = 0, single payment at n.

$$\text{Eq. 1} \qquad V_t^C = V_o\,(1+i)^t$$

$$= (1+i)^t \qquad \text{, where } V_o = 1$$

$$\text{Eq. 2} \qquad V_t^I = V_n\,(1+i)^{t-n} \qquad \text{, where } (1+i)^{t-n} = \frac{1}{(1+i)^{n-t}}$$

$$= (1+i)^n\,(1+i)^{t-n} \qquad \text{, where } V_n = (1+i)^n$$

$$= (1+i)^t \qquad \text{, add exponents}$$

$$\text{and} \quad (1+i)^t = (1+i)^t \qquad \text{, Eqs. 2 and 3}$$

$$\text{therefore} \quad V_t^C = V_t^I \qquad \text{, given premises.}$$

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[13] Alfred A. Ring, The Valuation of Real Estate, Englewood Cliffs, N.J., 1970.

[14] J. Fred Weston and Eugene F. Brigham, Essentials of Managerial Finance, 2d ed., New York, 1971.

Case 2 Valuation premises: $V_o = V_n$; $Ro = Rn$ (perpetuity).

Eq. 1 $V_t^I = R_n \left(\frac{1}{i} \right)$

Eq. 2 $V_t^C = R_o \left[\frac{1}{\frac{i}{(1+i)^{n-1}}} \right]$

$= R_o \left(\frac{1}{i} \right)$, where $n \rightarrow \infty$, and

$\frac{i}{(1+i)^{\infty} -1} \rightarrow i$

and $R_o (\frac{1}{i}) = R_n \ (\frac{1}{i})$, given Eqs. 1 and 2

$R_t (\frac{1}{i}) = R_t \ (\frac{1}{i})$, since $R_o = R_n = R_t$

therefore $V_t^C = V_t^I$, given premises

Case 3 Valuation premises: $R_o = R_n$, $V_n = 0$.

Eq. 1 $V_t^C = V_o \ (1-A)$, where A = amortization (or appreciation if + A)

$= V_o(1) - \left[\frac{i}{(1+i)^{n}-1} \right] \left[\frac{(1+i)^{t}-1}{i} \right]$, where A =(sinking fund factor at period n) (FW of annuity at period t)[15]

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[15] Financial Publishing Company, Financial Compound Interest and Annuity Tables, 3d ed., Boston, 1961.

$$= 1 - \left[\frac{i}{(1+i)^{n}-1}\right]\left[\frac{(1+i)^{t}-1}{i}\right], \text{ where } V_o = 1$$

Eq. 2 $$V_t^I = R\left[\frac{1-(1+i)^{t-n}}{i}\right], \text{ where } \frac{1-(1+i)^{t-n}}{i} = \text{Present}$$

worth of an annuity factor for n-t periods[16]

$$= \left[\frac{i}{1-(1+i)^{-n}}\right]\left[\frac{1-(1+i)^{t-n}}{i}\right], \text{ where } R = \text{partial}$$

payment factor for period n[17]

and $$1 - \left[\frac{i}{(1+i)^{n}-1}\right]\left[\frac{(1+i)^{t}-1}{i}\right] = \left[\frac{i}{1-(1+i)^{-n}}\right]\left[\frac{1-(1+i)^{t-n}}{i}\right],$$

from Eqs. 1 and 2

Proof of equality[18]

therefore $V_t^C = V_t^I$

Case 4 Valuation premises: $R_o = R_n$, $V_n < V_o$ and $V_n \neq 0$.

Eq. 1 $$V_t^C = V_o(1-A) + V_n(1+i)^{t-n}, \text{ from Cases 1, 2, 3}$$

$$= V_o(1) - \left[\frac{i}{(1+i)^{n}-1}\right]\left[\frac{(1+i)^{t}-1}{i}\right] + V_n(1+i)^{t-n},$$

from Case 3

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[16] Ibid.

[17] Ibid.

[18] A lengthy algebraic proof of the equality has been worked out, but is not shown since it can be easily established from the appropriate factor tables represented by the equations. See, for example, Financial Compound Interest and Annuity Tables, cited above.

$$= 1 - \left[\frac{i}{(1+i)^{n}-1}\right]\left[\frac{(1+i)^{t}-1}{i}\right] + (1+i)^{t-n},$$

where $V_o = 1$, and $V_n = 1$

Eq. 2 $$V_t^I = R\left[\frac{1-(1+i)^{t-n}}{i}\right] + V_n(1+i)^{t-n},$$

from Cases 1, 2, 3

$$= \left[\frac{i}{1-(1+i)^{-n}}\right]\left[\frac{1-(1+i)^{t-n}}{i}\right] + (1+i)^{t-n},$$

from Case 3 and where $V_n = 1$

and $$1 - \left[\frac{i}{(1+i)^{n}-1}\right]\left[\frac{(1+i)^{t}-1}{i}\right] + (1+i)^{t-n}$$

$$= \left[\frac{i}{1-(1+i)^{-n}}\right]\left[\frac{1-(1+i)^{t-n}}{i}\right] + (1+i)^{t-n},$$

from Eqs. 1 and 2

Proof as in Case 3

therefore $V_t^C = V_t^I$, given the premises.

The nature of the valuation process under conditions of certainty, or given specified premises, is visually demonstrated by stock and flow diagrams in Figure I.

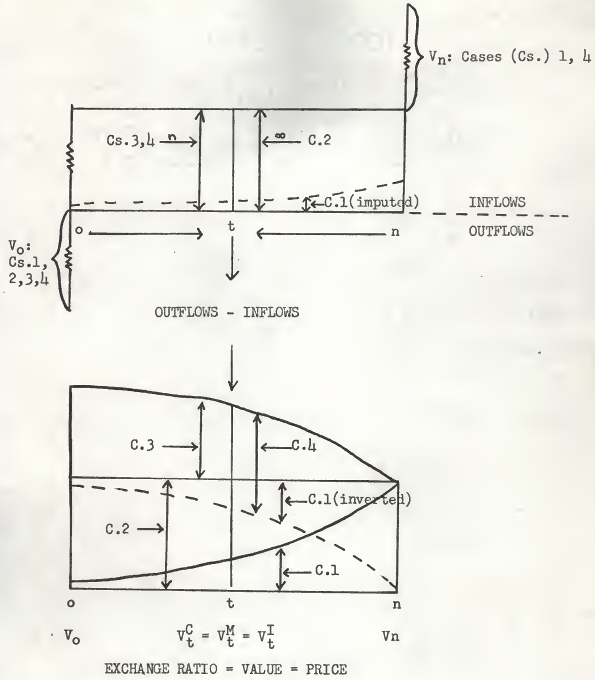

Figure I - Flow and Stock Diagrams of the Four Determinate Valuation Models in Chapter II, Based on the Premises in Cases 1, 2, 3 and 4

The preceding analysis is intended to demonstrate the validity of estimating market value via alternative valuation processes based on past, present and future exchange ratios and income flows. The equality of the estimates, viz., $V_t^C = V_t^M = V_t^I$, is derived from the premises, which are given and presumed to be true. In such cases, a determinate solution is possible.

Case 4 is a very useful model since it is general enough to cover problems involving land (case 1) and building (case 3) valuations, as well as more specialized appraisal assignments such as leasehold valuation problems. It is possible to modify the model to incorporate the impact of terms of finance on equity valuations. One such model has been developed by Ellwood.[19] The model could be further modified to reflect changes in market value attributed to growth, inflation, etc., where the rate of change is known and is assumed constant over the investment. This would require additional terms to incorporate the impact of the expected rate of growth, g, on the annuity income and the imputed income from the single payment to be received at period n.

Babcock, in his treatise Valuation of Real Estate, developed six variations of the model in case 3.[20] Where case 3 assumed an annuity over the life of the investment, Babcock relaxed this assumption to deal with the following income flow patterns: linear decline, linear rise, curvi-linear decline at various rates of decline, curvilinear systematic rise and decline, and irregular rises and declines.

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[19] L.W. Ellwood, Ellwood Tables for Real Estate Appraising and Financing, Chicago, 1967.

[20] Frederick M. Babcock, The Valuation of Real Estate, New York, 1932.

Models, similar to those developed by Babcock, could be developed to incorporate periodic changes in the market rate of interest over the life of the investment. However, as long as the premises of the valuation problem are known with certainty or assumed to be true, it can be proven that the equality

$$V_t^C = V_t^M = V_t^I$$

remains true.

The equality of the estimating equations may be established by an examination of the investment inflows and outflows, along the lines discussed by Boulding in Economic Analysis.[21] The following analysis is an alternative statement of the preceding cases.

Let:

V_o, V_n, V_t^C, V_t^I = Same as defined in cases 1 .. 4

E = Expenditure of cash on investment (= V_o in the four cases)

Y = Interest income on capital invested during a given period. The flow may be positive or negative (disinvestment), actual or imputed - such as where a single payment is to be received when the investment is liquidated. The interest income is to be allocated to the period in which it is earned.

R = Revenue or aggregate net income from invested capital p = subscript indicating past transactions = period from beginning of investment to a specified point in time, t, e.g., t = 120

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[21] Kenneth E. Boulding, Economic Analysis, 4th ed., New York, 1966.

f = subscript for future transactions, e.g., specified time, t = 120 to n = 300, when the investment is completely liquidated.

* = superscript indicates the total flow over the life of the investment, i.e., from periods o to n.

The complete life of an investment may be viewed as a series of economic events involving flow variables. Given the specified premises, the value of the investment can be measured by analyzing the inflows and outflows. Assuming that the interest income is allocated to the period in which it is earned, the following equations indicate the nature of the valuation process using investment inflows and outflows.

Eq. 1 $E^* = Ep + E_f$

(also $A^* = Ap + A_f$) (where A = amortization in the diagram below)

2 $R^* = Rp + R_f$

3 $Y^* = Yp + Y_f$

4 $Y^* = R^* - E^*$

(and $E^* = A^*$) (in the diagram)

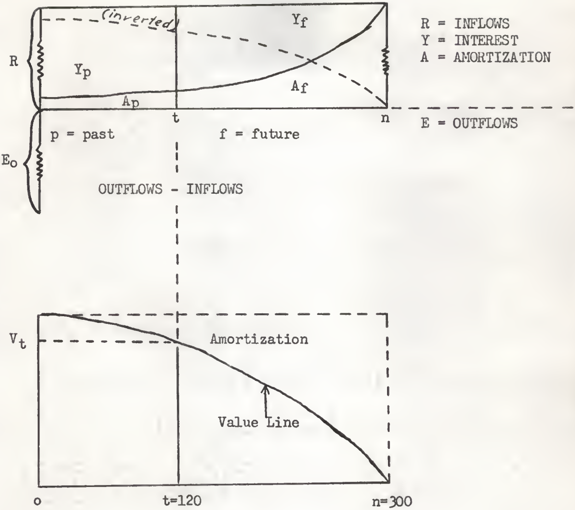
5 $V_t^C = Ep - Rp + Yp$, given Eqs. 1, 2, 3, 4

6 $V_t^I = R_f - E_f - Y_f$, given Eqs. 1, 2, 3, 4

7 $Ep - Rp + Yp = R_f - E_f - Y_f$, Eqs. 5 = 6, given Eqs. 1, 2, 3, 4

8 $V_t^C = V_t^I$

The equations and equality can be seen in the flow and stock diagrams in Figure II, which are based on the premises from case 3.



$$V_t^C = E_p - R_p + Y_p$$

$$V_t^I = R_f - E_f - Y_f$$

$$V_t^C = V_t^I$$

EXCHANGE RATIO = VALUE = PRICE

Figure II - Flow and Stock Diagrams of the Income Allocation Model in Chapter II, Based on the Premises in Case 3

Where the interest income has been allocated to the period in which earned, the outflows (expenditures) up to a given date, less inflows (revenue) from the investment and plus interest income earned, are equal to the present market value of the investment, based on the historical cost method (V_t^C). On the other hand, the expected future inflows (revenue), minus future outflows (expenditures) and minus future interest income, are equal to the present value of the investment, i.e., market value based on the future income method (V_t^I).

The example above is elementary, but the conclusions apply equally to other investments, such as those examined by cases 1, 2 and 4. It is also important to note that the equality holds even where there are changes in future expectations. For example, given an unexpected increase in Y_f, holding E constant, there would be a concomitant and equal increase in R_f. This can be seen in the diagram since $E^* = A^*$, and E^* is assumed to be constant, hence $\Delta Y = \Delta R$.

If the increase in Y is allocated entirely to the future, then the $\Delta Y_f = \Delta R_f$, which leaves V_t^C and V_t^I equal and unchanged - even though one estimate is based on the past (certainty) and the other on the future (uncertainty). This is true since, by equation 6, $V_t^I = R_f - E_f - Y_f$. The change in Y_f is exactly offset by the change in R_f (where E_f is constant).

On the other hand if the increase in Y is allocated to Y_p and Y_f, past and future, then V_t^C and V_t^I will change by equal amounts, since, by equation 5, $V_t^C = E_p - R_p + Y_p$, and, by equation 6, $V_t^I = R_f - E_f - Y_f$. In both periods there are equal and offsetting changes in Y and R - thus preserving the equality.

The preceding analysis and conclusions can be confirmed by an example. Assume: \$10,000 monthly amortizing mortgage, 6 percent nominal rate of interest, and 25 year term (monthly payment = \$64.43). The value of the mortgage investment at $t = 120$ is \$7,636.[22] At t plus one day assume that unexpectedly the government decrees that the nominal interest rate on all existing mortgages be increased by 1 percent, effective immediately. Although implausible, the following results are obtained. R (monthly payment) increases to \$68.62, $Y_f = \$754$, but the present value of the mortgage is unchanged at $V_t^C = V_t^I = \$7,636$, if the entire increase in interest payments is allocated to the future. The equality holds since the increase in interest income is being discounted at the higher rate from which it was derived, i.e., the present worth of an annuity factor for 7 percent, 180 periods (n-t) is the reciprocal of the partial payment factor used to determine the monthly payment.[23]

Where the increase in interest income, $Y = \$754$, is to be allocated evenly over the life of the mortgage, the monthly payment would increase from the original payment of \$64.43 to \$66.94, which when discounted at 6 3/8 percent yields V_t^I = \$7725 (approximately). The same valuation is obtained via the cost method by equation 5, \$10,000 - 8,033 + 377 = 7712 (difference of \$13 due to rounding). Thus $V_t^C = V_t^I$ remains true, but the value at t = 120 is slightly higher due to the allocation of the interest income over both periods.

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[22] The value can be estimated via the historical cost or future income methods. The individual calculations are based on case 3 equations, and the value conclusions are processed below by using the inflow - outflow format.

Eq. 1 \$10,000 = \$10,000 + 0
2 \$19,329 = 7732 + 11,597
3 \$ 9,329 = 5368 + 3,961
4 \$ 9,329 = 19,329 - 10,000
5 \$ 7,636 = 10,000 - 7732 + 5368
6 \$ 7,636 = 11,597 - 0 - 3,961
7 \$10,000 - 7732 + 5368 = \$11,597 - 0 - 3,961
8 \$ 7,636 = \$7,636

[23] Financial Publishing Company, Financial Compound Interest and Annuity Tables, 3d ed., Boston, 1961.

The preceding discussion on the foundations of real estate valuation indicates the role of exchange ratios, income flows and time in the valuation process. The analyses were predicated on the premises being true or known with certainty. Where this is the case, interest income can be allocated to the period in which it was earned, the proper amount of amortization can be ascertained at any time t, and the appropriate compound and discount factors can be specified. Given the premises, the market value can be readily estimated by any of the alternative valuation methods since the solution is determinate.

The independence and equality of the estimating equations do not necessarily hold for valuation problems under conditions of uncertainty, the usual market situation. Nevertheless, the concepts are useful to illustrate the nature of the valuation process, and are important foundations of valuation.

CHAPTER III

A CRITICAL ANALYSIS AND EVALUATION OF CONVENTIONAL REAL ESTATE APPRAISAL METHODOLOGY

Review of Conventional Real Estate Appraisal Methodology

The appraisal process exemplifies conventional appraisal methodology, as expounded by the American Institute of Real Estate Appraisers.[1] The process commonly serves as an outline for the appraisal report and represents the accumulated experience and wisdom of the appraisal fraternity.[2] Virtually all practicing appraisers and most real estate academicians subscribe to this conceptual approach to estimating market value.[3]

The conventional appraisal process can be summarized as follows:

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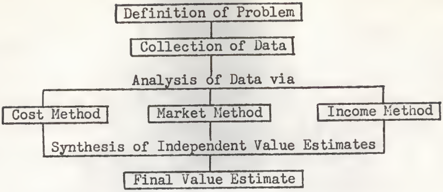
[1] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

[2] George L. Schmutz, The Appraisal Process, Manhattan Beach, California, 1959.

[3] Alfred A. Ring, The Valuation of Real Estate, 2d ed., Englewood Cliffs, New Jersey, 1970.



The heart of the appraisal process is obviously the methods of analysis. The appraiser is urged, when feasible, to use all three methods to estimate value, as each is held to be a fundamental part of the procedure.[4]

The cost method is based on the premise that value is determined, or at least can be measured, by current cost of production, less accrued depreciation.[5] This method of estimating value reflects the influence of classical theories of value.[6] The appraiser estimates value by the cost method as follows: $V = C - D$ (plus land value which is estimated by market method), where V = value (of improvements), C = current opportunity cost of replacing the utility of existing improvements, and D = depreciation, defined as a loss in value due to all causes (thus an equality, viz., $V_t^C = V_t^M$, is implied). Presumably founded on the notion of opportunity cost[7] and classical theories of value, the Institute asserts that the cost method is expected to provide a ceiling of value, i.e., the estimate by this approach is expected to be the highest of the three "independent" estimates.[8]

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[4] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

[5] Ibid.

[6] See: Jacob Oser, The Evolution of Economic Thought, 2d ed., New York, 1970; and Paul F. Wendt, Real Estate Appraisal: A Critical Analysis of Theory and Practice, New York, 1956.

[7] Paul A. Samuelson, Economics: An Introductory Analysis, 7th ed., New York, 1967.

The application of the cost method requires that the cost of replacing the utility stream be estimated, based on current technology and state of the arts. The usual procedure is to determine the cost per square foot of the various building components, such as basic living area, garage, etc., for "similar" new construction. These cost factors, adjusted for degree of comparability, are then multiplied by the quantity of the respective components for the property under appraisement to derive estimated replacement cost on an "as if" new basis. Depreciation is typically estimated by "observing" the accrued depreciation which is attributable to physical deterioration of the structure, functional obsolescence of the design and equipment, and economic obsolescence due to factors external to the subject property, e.g., changes in neighborhood characteristics, new adverse environmental influences, etc. (vis-a-vis what the situation was for the subject property when new, or in comparison to "similar" new houses).[9]

The market method, on the other hand, is based on the notion that current sales prices of "similar" properties should be an indication of the value of the property under appraisement.[10] The value conclusion is thus based on an analysis of recent sales, with appropriate adjustments to reflect the degree of comparability of the sale and subject properties with respect to improvements, lot, neighborhood, location, etc.

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[8] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

[9] Ibid.

[10] Ibid.

The market approach is the primary method used to estimate land values and the value of residential properties, but is also used in the appraisement of other classes of property, such as "income" property. The appraiser typically uses three to six comparable sale properties to provide the premises for the value conclusion.

The income method is based on the widely accepted notion that value may be measured by the discounted stream of utility (using income as a surrogate) expected over the remaining economic life of the property being valued.[11] This concept may be summarized as follows.

$$V_o = \frac{R - E}{\frac{i}{1 - \frac{1}{(1+i)n}}}$$

where: V_o = present market value

R = stabilized (weighted average) annual revenue[12]

E = stabilized annual expenses required to produce net income stream

i = market rate of interest

n = estimated economic life of asset

The forecasted income and expenses are based on a market analysis of "similar" income properties to determine the "economic" rent and expenses which are warranted for the subject property, i.e., the present contract rents are not used as the basis of the value estimate (unless the property is encumbered with long-term leases) but rather an attempt is made to determine "what the market will bear" given prevailing supply and demand conditions.[13]

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[11] Frederick M. Babcock, The Valuation of Real Estate, New York, 1932.

[12] Alfred A. Ring, The Valuation of Real Estate, 2d ed., Englewood Cliffs, New Jersey, 1970.

The rate of interest used to capitalize the net income flow is likewise based on market comparisons. A number of alternative procedures are currently utilized, such as "band-of-investment" technique (weighted cost of capital) and the "comparative" method.[14] The latter is based on a determination of the actual or imputed market rates of interest for "comparable" income properties which recently sold. This requires a determination of sale prices of the "comparables", adjustments for degree of comparability, a determination of the net incomes of the respective properties, and an imputation of market rates of interest based on the net incomes and sale prices.

These three "independently" derived estimates are then synthesized, following current practice, into a final estimate of market value. The appraiser is instructed not to average the three indications of value. Rather he is to examine the range of estimates, and place the greatest judgmental weight on the most reliable method.[15] Where the three methods yield widely divergent estimates, the appraiser is urged to reexamine and evaluate the data and procedure. If no data or judgmental errors are found, then the appraiser is to "explain the cause" of the divergent estimates.

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[13] Ibid.

[14] Ibid.

[15] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

The Efficacy of Conventional Real Estate Appraisal Methodology

The proposition, that $V_t^C = V_t^M = V_t^I$, is theoretically sound. It was demonstrated that the equality can be established at a specified time, t, under conditions of certainty or if the premises are assumed to be true. It is also clear that once we have certainty, such as when the investment is liquidated, the equality can be reestablished for any past point in time, n-t, by allocating the income flow over past and future periods as discussed earlier. In practice, the equality is not so easily established since the methods can not assume that the premises continue to be true, rather they must be established in a market characterized by uncertainty.

V_t^M can be estimated by an analysis of current market transactions, but of course must be stated as a probability - since the appraiser is operating without perfect knowledge. Since the appraiser can not rely on deductive methods as the logical basis for the value conclusion, he is required to use inductive methods. The logical procedure currently used to infer the market value is the compound analogy. Although the term may not be familiar to most appraisers, there is almost complete agreement that V_t^M for the subject property is conventionally based on several recent "sale properties", adjusted for degree of comparability[16] - which is an application of this type of logical argument.[17]

The "cost method" valuation problem can be analyzed by reference to the equation in case 1 discussed earlier, namely, $V_t^C = V_o(1+i)^t$. This equation contains four variables: V_t and i are unknown, t is known, and V_o is known if based on historical cost and unknown if based on estimated replacement cost. Regardless of whether V_o is based on historical or current replacement cost, a number of conclusions are evident.

1. A solution to the equation requires that:
    a. i be estimated by market comparisons - which ultimately, in this case, implies a particular V_n since the market rate, estimated at t, can not be presumed unless it is expected that a particular sale price will prevail at n. For example, since a zero annuity and single payment at n is assumed, the market would attribute a zero rate of interest to the investment if the market, at t, forecasted that V, at n, would be zero, i.e., in this case the investment is worthless regardless of the cost, V_o.
    b. or V_t must be estimated by the market and/or income methods. In this case, i would simply be an internal rate equal to the market rate of interest.

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[16] Ibid.

[17] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956; and Irving M. Copi, Introduction to Logic, 2d ed., New York, 1961.

2. V_t^C must be a probability statement as a consequence of "a" or "b" above.

Thus it appears that in the final analysis - under conditions of uncertainty - present market value can not be derived via the cost method without reference to the current market conditions and some form of inference, such as the compound analogy. This conclusion agrees with the postulates that value in the final analysis is based on utility, and it is expected utility which gives an economic good its value attribute.

Conventional appraisal methodology attempts to retain the cost approach as an "independent" method by defining a tautology, namely, that $V_t^M \equiv V_t^C \equiv C - D$, where C = current opportunity replacement cost, and D = depreciation, i.e., a loss in value due to all causes.[18] Presumably if C and D could be independently estimated, then the integrity of the method could be preserved. In this case, the appraiser must cope with two unknowns, namely, C and D.

Since the appraiser does not make value but simply tries to estimate it, the market must be ultimately relied upon to determine the competitively priced cost of production and the amount of depreciation which the market attributes to the property under appraisement. Current appraisal practice determines replacement cost, explicitly or implicitly, by using a compound analogy as illustrated below. If this is not the case, then a logical argument is not being used - as the conventional procedure used to estimate replacement cost does not even closely resemble any of the other recognized types of logical argument.[19]

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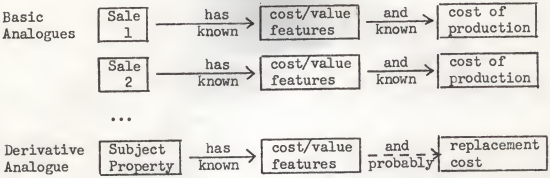
[18] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.



The estimated replacement cost is subject to the usual logical weaknesses of the compound analogy method of analytical procedure, namely, the strength of the inference depends on the number of analogues, and the similarities and dissimilarities of the analogues.[20] The latter seems to be a fundamental and serious weakness of the cost approach. How similar, or dissimilar is a thirty-year-old property with new properties -- the premises used to derive the estimate?

Since the preceding inference refers to replacement cost new, i.e., probable replacement cost of the subject property on an "as if" new basis, a further adjustment is required to determine depreciation. It is necessary, in the final analysis, to compare the sale price of "similar" old properties (premises) with current production of "similar" properties (derived by compound analogy above) in order to determine the estimated amount of depreciation the market attributes to the subject property. The estimated depreciation may then be allocated or attributed to physical and economic causes, thus preserving the equality $V_t^C = V_t^M$. It is obvious that the compound analogy used to estimate depreciation is, in effect, the same or similar to the analogy used to establish V_t^M. Hence an "independent" method has not been used to estimate V_t^C.

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[19] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956; and Irving M. Copi, Introduction to Logic, 2d ed., New York, 1961.

[20] Ibid.

Thus both replacement cost and depreciation are based on compound analogues, with the estimated amount of the latter being significantly influenced or determined by the value estimate derived by the market method, V_t^M. The essence of this view seems to be shared by at least one leading academician. Professor Ratcliff states that:

> It should be clear that if this base figure, cost, is a meaningless figure in the first place, as it clearly is when the structure is old and obsolete, then this meaningless figure as adjusted by depreciation is also meaningless, unless the appraiser has already arrived at a final value figure by other means and fudges the depreciation adjustment so that the net adjusted value figure is close to his already determined value. We will accuse many appraisal practitioners of doing just this in many cases, for, in fact, they have little choice if compelled to employ the cost approach.[21]

The future income method is sound in theory and in practice. The following equation (see case 3) indicates the nature of the "income method" valuation problem under conditions of uncertainty and identifies the relevant variables.

$$V_t^I = R \left[\frac{1-(1+i)^{t-n}}{i} \right]$$

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[21] Richard U. Ratcliff, "Real Estate Valuation and Highway Condemnation Awards," Wisconsin Commerce Reports, University of Wisconsin at Madison, Vol. VII, No. 6, June, 1966, pp. 27-28.

where: R = revenue based on economic rent

t = date of appraisement

n = expected economic life of revenue stream

i = market rate of interest

In the valuation model, t is known, R and n are forecasts, and i is a current market determination. Clearly, the market value in this situation can only be stated as a probability.

It is obvious that the forecasts can not be independent opinions of the appraiser; rather the forecasts of R and n must be a reflection of the current "opinion" of buyers and sellers since they establish market value. Thus it appears that the compound analogy, or some other form of logical argument, must also be used to establish market estimates for R, n and i. Once estimates of R, n and i for the subject property have been inferred from an analysis of the market data, the value estimate may be processed by an appropriate valuation model, e.g., those discussed in cases 1, 2, 3 and 4. An analysis of appraisal literature will establish that the estimated value by the market method is currently based on the compound analogy, implicitly or explicitly.[22] This subjects the income method to the basic weaknesses of the analogical argument as discussed earlier.

This analysis tends to support the views of Professors Ratcliff and Wendt regarding the efficacy of conventional real estate appraisal methodology.[23] However their criticisms focus mainly on the theoretical foundations of the alternative methods under conditions of uncertainty, while this study identifies the compound analogy form of logical argument, which is used almost exclusively in current appraisal practice, as the fundamental source of the replication problem and the reason for the paucity of reliable knowledge concerning price-value relationships in the urban residential housing market. As one logician noted, an inference, e.g., value estimate, can be strengthened by changing the content or the form of the logical argument.[24] The purpose of this study is to test the plausibility and feasibility of the latter alternative.

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[22] See: Richard U. Ratcliff, Current Practices in Income Property Appraisal: A Critique, Research Report No. 30, The Center for Real Estate and Urban Economics, University of California at Berkeley, 1967; and American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

The preceding analysis and conclusions may be summarized as follows:

1. The cost, market and income methods are theoretically sound, given perfect information, or specified premises.
2. A valuation based on imperfect knowledge is an inference and should be stated as a probability.
3. The value estimate derived by the cost approach, under conditions of uncertainty, is based ultimately on current market comparisons similar to the market method. The cost method appears to be a superficially "independent" approach and its use probably cannot be justified

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[23] Richard U. Ratcliff, "A Restatement of Appraisal Theory," Wisconsin Commerce Reports, Vol. VII, No. 1, University of Wisconsin at Madison, 1963; and Paul F. Wendt, Real Estate Appraisal: A Critical Analysis of Theory and Practice, New York, 1956.

[24] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956.

except where the market and income methods are clearly not applicable.

4. The future income method is sound in theory and in practice. It is based in the final analysis on current market comparisons.
5. Value estimates by the cost, income and market methods are based ultimately on current market data and a comparison of the subject property, or specified variables, with "similar" properties in the market, with adjustments for degree of comparability.
6. A number of writers, including this one, have seriously questioned the efficacy of current real estate appraisal methodology on empirical and logical grounds.
7. Conventional appraisal practice relies heavily on the compound analogy as a logical argument. Its strengths and weaknesses are a function of the number of basic analogues, and the extent of similarity and disparity between the basic and derivative analogues.
8. One way to increase the strength of an inference, e.g., a value conclusion, is to change the form of the logical argument.
9. The viability of an alternative form of logical argument seems to warrant investigation.

CHAPTER IV

A THEORY OF PRICE DETERMINATION IN A DEFINED URBAN RESIDENTIAL HOUSING MARKET

The Postulated Theory

A theory is initially a hypothesis, and may be defined as a tentative high-level generalization that seeks to explain and systematize real world phenomena.[1] A theory is confirmed (i.e., consistently not rejected) by deducing from it lesser generalizations, and ultimately specific hypotheses which can be tested for their empirical validity, i.e., do the facts agree with the theory. Thus the logical method from theory to fact is deductive, while empirical inquiry relates fact to theory by induction.

The aim of this chapter is to postulate a theory of urban residential price determination to guide the development of an empirical model. A theory may be founded on a priori considerations, existing theoretical propositions, and empirical generalizations from observation and experience. All of these sources are utilized in deriving the postulated theory of market behavior.

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[1] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956.

A priori premises: buyers and sellers can order alternatives, and the exchangors seek to maximize their own welfare.[2] Postulated Theory: exchange ratios in a defined urban residential housing market are determined by a bargaining process between a finite number of buyers and sellers of a heterogeneous product in a dynamic environment, with the price of a particular property being a function of: product specification; subjective valuations; past, present and expected future exchange ratios of the subject and substitute properties; past, present and expected future levels and elasticities of supply and demand; dynamic environmental factors; information system; and interaction of buyers and sellers.

The urban residential market structure can be generally characterized as bilateral oligopoly, broadly defined to include new and resale housing.[3] A conceptualization of the theory is presented in Figure III. An examination of the market model reveals a number of explicit or implicit features of the theory.

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[2] William J. Baumol, Economic Theory and Operations Analysis, 2d ed., Englewood Cliffs, New Jersey, 1965.

[3] This is a general characterization since the term is usually applied in economic analysis to producers and consumers of the initial productive process, i.e., price and output determination. The "resale" market is not customarily included in an analysis of market structure. However the use of the term seems justified where only price (and not output) determination is being investigated, since many of the features of a bilateral oligopoly structure do characterize the new and resale urban residential market, e.g., a relatively small number of buyers and sellers of a heterogeneous product, indeterminancy of price, etc. For a discussion of this structure, see Richard A. Bilas, Microeconomic Theory, New York, 1967.

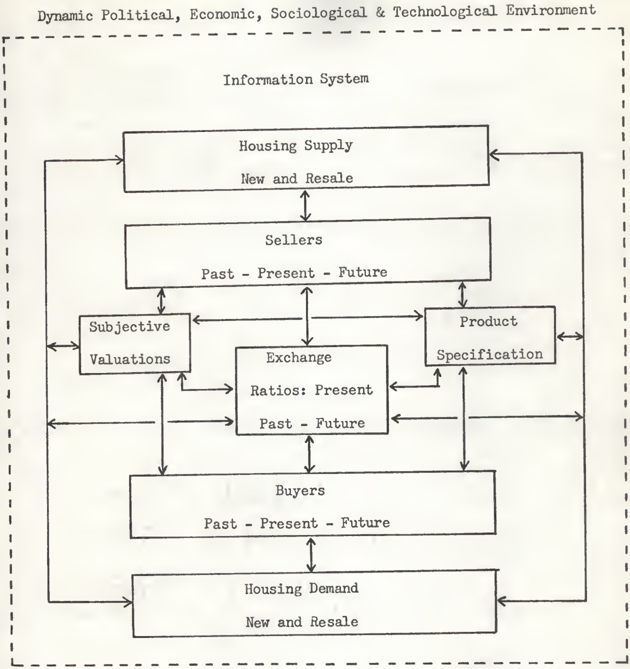

Figure III - A Model of Price Determination in a Defined Urban Residential Housing Market

1. The model recognizes that the market is dynamic.[4] Market valuations, as discussed in chapter two, are founded on past, present and expected future exchange ratios, which are in turn determined by an interaction of market elements.[5]
2. A general quasi-equilibrium system is postulated.[6] Many factors interact to determine the general level and structure of prices, with the actual exchange price being indeterminate due to the bargaining process.[7]
3. Supply and demand are founded on the economic processes of production and consumption, respectively.[8] Supply is based on a transformation of land, labor and capital in a technological environment, while demand reflects the expected utility to be derived from consumption. The level and intensity of demand is influenced by past, present and expected future prices of the subject and substitute products, income levels and wealth, tastes and preferences, expectations regarding future supply and demand conditions, etc.[9]

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[4] Kenneth E. Boulding, Economic Analysis, 4th ed., New York, 1966.

[5] Ibid.

[6] William J. Baumol, Economic Theory and Operations Analysis, 2d ed., Englewood Cliffs, New Jersey, 1965.

[7] Kenneth E. Boulding, Economic Analysis, 4th ed., New York, 1966.

[8] Ibid.

[9] Richard A. Bilas, Microeconomic Theory, New York, 1967.

4. The model encompasses new and resale housing, with the two interacting to influence the level and structure of prices.
5. The market elements are linked by an information system - which influences the efficiency of the exchange mechanism.
6. Some specification of the heterogeneous product is required in order to evaluate the alternatives (based on a priori premises).
7. Subjective valuations are influenced by: product specification; the expected utility to be derived from the consumption of the specified product; buyers' and sellers' "programmed" behavior; past, present and expected future exchange ratios (which are influenced by supply and demand, etc.); environmental factors; information system, and interaction of buyers and sellers.
8. Prices, i.e., actual exchange ratios, are determined by an interaction of all the elements in the market system, as stated in the postulated theory.

Lesser Generalizations

The postulated theory is a high-level generalization which seeks to "explain" residential market behavior. Since a theory is too general to test directly, it is customary to deduce from the theory a number of lesser generalizations - from which specific hypotheses may be deduced in order to empirically test the theory.

The purpose of the inquiry was not to tentatively confirm a theory, but rather to develop a predictive model for pragmatic reasons. A theory of price determination was postulated to guide the development of an empirical model for this and other residential markets. An undue attempt was not made to postulate a theory based on an impeccable logical system. Thus the postulated lesser generalizations in this study have been founded on economic propositions and empirical generalizations from observation and experience, rather than seeking to formally deduce them from a theory which was not formulated for that purpose. The following lesser generalizations are presumed to be logically consistent with the postulated theory, or at least they do not appear to be patently inconsistent.

1. Bargaining presupposes a conflict of interest. The objectives of the parties are inconsistent, i.e., sellers desire to sell dear and buyers wish to buy low.[10]
2. Exchanges occur, in the absence of compulsion, because the transaction is mutually beneficial to the respective parties. A range of mutually beneficial exchange ratios presumably prevails if a transaction is to occur (defined to include a one-price range).[11]

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[10] This is customarily analyzed by the use of indifference and contract curves (i.e., by use of the Edgeworth Box). See: Richard A. Bilas, Microeconomic Theory, New York, 1967.

[11] Ibid.

3. A structure of prices exists for a heterogeneous product in a given market and time. The structure of prices will be related to a product specification or classification system.
4. The general level of prices is determined by an interaction of market elements, e.g., supply and demand, etc., in a dynamic environment.
5. Subjective valuations are influenced by the expected utility flow to be derived from the consumption of a specified product, and "programmed" behavior.
6. The residential housing product is heterogeneous. Important factors which differentiate residential properties are: improvement, site, neighborhood, and location. (This is not an exhaustive enumeration of factors, but are those considered to be relevant and measurable for the purpose of this inquiry.)[12]
7. The equilibrium exchange ratio for a specified product is indeterminate within the range of mutually beneficial prices, with the actual price established by the bargaining process.[13] The price is influenced by: "programmed" behavior of the exchangers; the relative bargaining power and skill of the parties; the quantity and quality of the market information received by

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[12] Alfred A. Ring, The Valuation of Real Estate, Englewood Cliffs, New Jersey, 1970.

[13] Richard A. Bilas, Microeconomic Theory, New York, 1967.

the participants; and miscellaneous conditions affecting the transactions, such as, urgency of decision, terms of finance, etc.

A General Model of Price Determination

An objective of the research is to identify strategic variables which influence price variations and then to determine, i.e., measure, their effect. If this is accomplished, then the specified relationships could be used to predict market value for real property taxation purposes, etc.

The postulated theory and lesser generalization are founded on a priori considerations, utilization of conventional economic propositions and empirical generalizations. Consistent with these premises, a model of residential price determination needs to acknowledge the influence of the elements of the market system, namely, supply and demand, subjective valuations, product specification, exchange ratios, exchangers, information system, and dynamic environmental factors.

It would be an enormous, if not impossible, task to develop an operational model incorporating all the postulated elements of the system. The problem can be simplified by carefully specifying the scope of the inquiry, and by basing the model on certain premises and/or assumptions, thereby reducing the elements of the system to be investigated.[14]

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[14] Ralph H. Blodgett, Our Expanding Economy, New York, 1955.

The scope of the study was limited to a static model of a specified segment of the urban housing market. Since the product is characterized by extreme heterogeneity, the approach of this study is to relate a system of product specification to the structure of prices. This portion of the model of market behavior is assumed to be determinate. The indeterminancy of prices due to the bargaining process and imperfections in the information system is incorporated into the model as an error term, while the general level of supply and demand, the structure of the market, and environmental forces are postulated to be relatively stable over the period under investigation.

A main hypothesis to be tested is that:

$$\hat{Y} = f\,(X_1,\ X_2,\ X_3,\ X_4,\ e \mid S,\ D,\ K_i)$$

where:

$\hat{Y}$ = expected or probable urban residential sale price in a specified market in the time period under consideration

X_1 = improvements

X_2 = site

X_3 = neighborhood

X_4 = location

e = error term

$\mid S, D, K_i$ = given supply and demand conditions and other market factors, i.e., these are assumed to be relatively stable during the short-run, say three months.

The simplest predictive model, consistent with the objectives of the study, seems warranted since little is known of the nature of the functional relationships influencing price determination. Regression analysis provides a simple, yet powerful, technique for investigating problems similar to those identified by this study. Draper and Smith note that a linear predictive model may adequately identify and describe the main elements and relationships of the system being investigated.[15] A multiple regression model is especially useful where little is known about the nature and behavior of the system. The regression model may help identify relevant variables, and may provide guidelines for further research.

Based on the premise that supply, demand and other market elements not specified in the model remain relatively stable during the period under investigation, a first-order linear regression model is used to test the statistical hypotheses regarding the relation of predictor variables to sale price.[16]

$$\hat{Y} = a_0 + a_1X_1 + a_2X_2 + \ldots + a_nX_n + e$$

where:

$\hat{Y}$ = estimated sale price or response variable

a_i = partial regression coefficients, or parameter estimators

X_i = predictor variables, or regressors

e = error term, assumed to be randomly distributed.

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[15] N.R. Draper and H. Smith, Applied Regression Analysis, New York, 1966.

[16] David S. Huang, Regression and Econometric Methods, New York, 1970.

The assumptions of the classical linear regression model to be used are:[17]

1. the values of $X_1, \ldots, X_n$ are fixed, i.e., determinate;
2. the random variables Y_i are statistically independent, with
    a. $E(\hat{Y}_i) = a_o + a_1X_1 + \ldots + a_nX_n$, where,
       $E(\hat{Y}_i)$ = expected mean of Y_i, given $X_1, \ldots, X_n$.
    b. and variance = ^{2} (i.e., homoscedasticity is assumed)
3. Or alternatively, since the distribution of $Y_i - \hat{Y}_i$ and e_i are the same except that the latter has been translated onto a zero mean, it is assumed that the error terms, e_i, are independent normally distributed random variables, with
    a. mean = 0
    b. variance = $\sigma^2 = 1$

To summarize, the assumptions are:

1. the values of the X_i regressors are fixed;
2. the expected mean of e_i is zero, and
3. $E(e^2) = \sigma^2 = 1$

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[17] See: David S. Huang, Regression and Econometric Methods, New York, 1970; and Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

CHAPTER V

AN EMPIRICAL MODEL OF PRICE DETERMINATION IN A DEFINED URBAN RESIDENTIAL HOUSING MARKET

The Variables

A theory, lower-level generalizations, and a generalized model of urban residential price determination were postulated in Chapter IV, and regression analysis was specified as the procedure to be used to measure the relationships.

The factors in the general model are not amenable to direct testing. Therefore to test the theory it is necessary to postulate specific hypotheses. The selection of the variables was based on theoretical economic propositions and empirical generalizations from experience and observation. The hypotheses were not deduced rigorously from the postulated theory of market behavior, but are presumed to be consistent with the theory.

The population to be sampled was defined in Chapter I. Sources of information, functional form and a more detailed description of each variable are found in Appendix A. A listing and summary description of the variables in the "selected" predictive model is in Table I of this chapter. Other variables tested and rejected are contained in Appendix G.

Table I - Definition and Acronym of Variables That Appear in Chapter V

Variable	Acronym	Description
Y	SALEPR	Sale price in dollars ($\hat{Y}$ = expected or estimated sale price)
X_1	QUNBLA	Quantity of square feet (S.F.) in the basic living area of the improvement
X_2	QUNAUX	Quantity of S.F. in auxiliary areas of the improvement, e.g., garage, patio, etc.
X_3	QULINX	Quality of construction index
X_4	AGEIMP	Chronological age of improvement
X_5	LOTSIZ	Quantity of S.F. in lot (size)
X_6	SITE 2[a]	Site facility rating of 2
X_7	NEIQL 2[a]	Neighborhood index:
X_8	NEIQL 3[a]	ratings 2, 3 and
X_9	NEIQL 4[a]	4
X_{10}	DISTUF [b]	Distance from University of Florida, measured at right angles
X_{11}	DTUFSQ [b]	$(\text{DISTUF})^2$
X_{12}	DISTMP [c]	Distance from "MP" zoned areas (heavy manufacturing), measured linearly
X_{13}	DTMPSQ [c]	$(\text{DISTMP})^2$
X_{14}	AREA W[a]	Area in West Gainesville, delineated from the East by Main Street

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[a] Dummy variables

[b] Quadratic function for distance from the University of Florida

[c] Quadratic function for distance from areas zoned "MP"

Dummy variables are used to account for the influence of qualitative or classification variables in the model. The value of the dummy variable for a given observation is 0 or 1 depending on the classification assigned to the property. For example, if a given property is rated NEIQL 3, then the NEIQL dummies used in predicting sale price would appear in the estimating equation as $a_7(0) + a_8(1) + a_9(0)$, i.e., only the value of the coefficient for variable X_8 is included in the prediction of sale price. Dummy variables are commonly used in empirical investigations and have been widely discussed in statistical and econometric literature.[1]

A number of the variables enter the equation as quadratic functions, namely, DISTUF, DTUFSQ and DISTMP, DTMPSQ. The X_i values of these second-order variables are transformed before the calculations are performed, permitting the use of a first-order (in X) linear (in the parameters) regression model. The development of the model was based on a limited range of transformed X_i values on the assumption that the quadratic functions approximate the true relationship over the range of values examined. Any predictions based on X_i values beyond the range used in constructing the model are precarious, i.e., little confidence can be placed in the estimate.

Multicollinearity of the data is a major problem in the study since it complicates the development of the model and limits the interpretation of the results.[2] The nature and extent of the problem are readily apparent: the "better" neighborhoods generally contain larger than average houses, with better than average quality of construction, and usually large lots with attractive topographical features. Thus if a type of neighborhood is specified, the magnitude of other variables is also to a large extent "determined". This will be a major problem and limitation in any residential market.

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[1] See: David S. Huang, Regression and Econometric Methods, New York, 1970; Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970; and Arthur S. Goldberger, Topics in Regression Analysis, London, 1968.

[2] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

Where multicollinearity exists, it is most difficult to obtain an accurate estimate of the true partial regression coefficients, and even the selected set of variables in the equation can be easily questioned, as an alternative set may yield similar results.[3] However for predictive purposes most writers agree reliable estimates may be obtained if no attempt is made to predict or forecast the response variable, e.g., sale price, by using values of the predictor variables, X_{ij} removed from their collinear context.[4] In other words, a properly specified model may predict reliable results when observed values of the regressors are used since the collinearity which influenced the estimated values of the coefficients presumably still characterizes the data. However it is hazardous to attempt to isolate the influence of a specified variable or to attribute a particular significance to the respective values of the partial regression coefficients. It is also precarious to predict Y using X_i values beyond the range investigated when constructing the model.

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[3] Ibid.

[4] David S. Huang, Regression and Econometric Methods, New York, 1970.

Model Selection: Criteria and Procedure

Many models were examined in the process of selecting the final model. In view of the multicollinearity problem, and since there are conflicting objectives, there is not a "best" model for a given market. The selection of the final model in this study was guided by the following considerations.[5]

1. The selected equation should be accurate and reliable. The following goals and standards were used: the standard error of the estimate, Se, should be low; the adjusted coefficient of determination, $\overline{R}^2$, should be high (0.92 was a target); and the equation should be statistically significant (an α error = .05 for the F test was used).[6]
2. The variables in the selected model should be: statistically significant (a 95% confidence level, based on an α = .05 two-tailed "t" test was used); logically supportable, i.e., consistent with theory and empirical generlaizations; and relatively stable over the sample space.
3. The fewest number of variables possible - consistent with other objectives - was an aim in view of the cost of information.

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[5] N.R. Draper and H. Smith, Applied Regression Analysis, New York, 1966.

[6] For a concise glossary of statistical terms and criteria, see William J. Fraser, Jr., The Demand for Money, New York, 1967.

4. The type of function used to relate the variables, where viable alternatives exist, was based on the following considerations, with the final choice being influenced by objectives one and two above: consistency with theoretical propositions, empirical "best" fit and simplicity.

The selection of the final model is an enormous task when there is a large number of variables to be tested and multicollinearity is a problem. The number of possible models, i.e., combinations of variables, may be literally thousands. The selection problem however may be greatly reduced by limiting the selection of variables to those which can be justified on theoretical and empirical grounds, and by following a selection procedure.

The final model in this study was selected by using several procedures.[7] A preliminary feel for the data was obtained by the use of descriptive statistics, simple regressions, scatters of all X variables with the Y variable, correlation matrix and plots of residuals. A tentative model was then selected using a "backward elimination procedure", i.e., all variables were initially included and then statistically insignificant regressors were systematically dropped from the equation. And, finally, the selected model was derived by a "forward selection procedure". The "tentative" model was used as the starting equation, and previously deleted variables were re-run with the model until a criteria-optimizing model was obtained.

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[7] N.R. Draper and H.Smith, Applied Regression Analysis, New York, 1966.

The use of two selection procedures, where multicollinearity is a problem, minimizes weaknesses individually inherent in each.[8] For example, if only the backward procedure is used, some significant variables may be deleted before their influence is manifested, i.e., their significance may not be apparent until other variables are deleted from the equation. Some writers recommend a "stepwise regression procedure", especially when used in conjunction with other procedures, such as "forward selection".[9] A stepwise regression program was used as a subsidiary procedure in this study.

The appendices contain computer print-outs summarizing relevant descriptive statistics, matrices, simple regression, scatters of certain X variables with the Y variable, and key equations tested in step three of the selection procedure. A careful analysis of the key equations reveals the difficulties of selecting the regression equation where multicollinearity is a problem, i.e., a selection procedure is needed; there is not a "best" model, rather the final model depends on the selection criteria; and the selected model satisfies most of the criteria of this study.

The Selected Model

The selected regression equation

$$\hat{Y} = a_1X_1 + a_2X_2 + \ldots + a_{14}X_{14}$$

was fitted to 163 observations of Y_i and X_{ij}, based on transactions in the Gainesville, Florida, residential market during the period October 1, 1970, to March 31, 1971. All sales occurring during the period were included in the sample if they met the specifications of the defined population (see Chapter I). The predictive model, based on least squares estimates of the coefficients, $a_1, \ldots a_{14}$, is presented below, with relevant statistics for evaluating the predictor variables and equation (all calculations rounded).[10]

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[8] *Ibid.*

[9] *Ibid.*

$$\begin{array}{llllll}
\hat{Y}_i = & 7.22\,X_1 & + & 3.82\,X_2 & + & 79.63\,X_3 \\
 & (s_1 = 0.55) & & (s_2 = 1.73) & & (s_3 = 12.77) \\
 & (t_1 = 13.22) & & (t_2 = 2.20) & & (t_3 = 6.24) \\
 & & & & & \\
 & -\ 174.57\,X_4 & + & 0.17\,X_5 & + & 745.87\,X_6 \\
 & (s_4 = 24.07) & & (s_5 = 0.05) & & (s_6 = 254.81) \\
 & (t_4 = 7.25) & & (t_5 = 3.21) & & (t_6 = 2.93) \\
 & & & & & \\
 & +\ 1156.38\,X_7 & + & 4214.57\,X_8 & + & 7433.98\,X_9 \\
 & (s_7 = 389.32) & & (s_8 = 631.35) & & (s_9 = 806.87) \\
 & (t_7 = 2.97) & & (t_8 = 6.68) & & (t_9 = 9.21) \\
 & & & & & \\
 & -\ 1666.36\,X_{10} & + & 126.47\,X_{11} & + & 1133.58\,X_{12} \\
 & (s_{10} = 355.61) & & (s_{11} = 31.54) & & (s_{12} = 315.56) \\
 & (t_{10} = -4.69) & & (t_{11} = 4.01) & & (t_{12} = 3.59)
\end{array}$$

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[10] William J. Fraser, Jr., *The Demand for Money*, New York, 1967.

$$- \ 64.52\, X_{13} \quad + \quad 817.13\, X_{14}$$

$$(s_{13} = 16.52) \qquad (s_{14} = 402.29)$$

$$(t_{13} = -3.91) \qquad (t_{14} = 2.03)$$

$$Se = \$1379.84$$

$$\bar{R}^2 = 0.95$$

$$F = 209.23$$

where:

$X_1, \ldots, X_{14}$ = regressors summarized in Table I

$s_1, \ldots, s_{14}$ = standard error of the estimated regression coefficient, $a_1, \ldots, a_{14}$, of the respective regressors

$t_1, \ldots, t_{14}$ = $a_1/s_1, \ldots, a_{14}/s_{14}$, all computed t values are significant at the 95% level (α type error = .05 /2 for the two-tail test)

Se = standard error of the estimate (for the equation)

$\bar{R}^2$ = coefficient of determination, adjusted for the degrees of freedom

F = computed F value

The model was tested with and without a constant term. The constant was suppressed in the selected equation, i.e., the regression surface intersects the Y axis at zero, since the value of the term was statistically insignificant, and the results of the model improved when it was dropped from the equation. One regressor from each set of dummies is dropped to avoid linear dependence, which is necessary in order for the computer to complete the computations.[11] In most cases the value and sign of the suppressed dummy can be inferred. For example, "Area E" has the same coefficient value as "Area W", but has a negative sign.

Interpretation of the Model

The main purpose of the model is to predict or forecast sale price, given the values of the predictor variables. For example, the expected sale price of observation number 163 can be predicted by the estimating equation as follows.

$$\begin{aligned} \hat{Y}_{163} = {} & 7.22\ X_1 + 3.82\ X_2 + 79.63\ X_3 - 174.57\ X_4 \\ & + 017\ X_5 + 745.87\ X_6 + 1156.38\ X_7 + 4214.57\ X_8 \\ & + 7433.98\ X_9 - 1666.36\ X_{10} + 126.47\ X_{11} + 1133.58\ X_{12} \\ & - 64.52\ X_{13} + 817.13\ X_{14} \end{aligned}$$

$$\begin{aligned} = {} & 7.22\ (2772) + 3.82\ (226) + 79.63\ (116) - 174.57\ (0) \\ & + 0.17\ (17400) + 745.87\ (1) + 1156.38\ (0) + 4214.57\ (0) \\ & + 7433.98\ (1) - 1666.36\ (4) + 126.47\ (16) + 1133.58\ (9) \\ & - 64.52\ (81) + 817.13\ (1) \end{aligned}$$

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[11] David S. Huang, Regression and Econometric Methods, New York, 1970.

$$= 20013.84 + 863.32 + 9237.08 - 0$$
$$+ 2958.00 + 745.87 + 0 + 0$$
$$+ 7433.98 - 6665.44 + 2023.52 + 10202.22$$
$$- 5226.12 + 817.13$$

$$= \$42,403.40$$

The expected or predicted sale price of about $42,400 may be compared with the actual sale price of $43,000. Obviously such accurate estimates are not always predicted by the model. See Appendix E for a plot of predicted versus actual sale prices for the 163 observations in the sample.

Statistical inferences are never certain. However, if the postulated generalizations regarding the determination of prices in the residential housing market are well founded, if the assumptions of the regression model are valid or nearly so, and if proper statistical procedures are followed, then a degree of confidence in the predicted or forecasted value of Y is warranted. And conversely, if the model predicts consistent results using data not known when the parameters were estimated (i.e., extra-sample observations), then a degree of confidence in the postulated generalizations is warranted. The validity of the assumptions of the model can generally be tested; the validity of the postulated theory and lesser generalizations can only be inferred.[12]

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[12] Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956.

The true parameters of the model, α_i, are of course not known, but may be estimated from a representative sample of the defined population. Statistical theory and empirical generalizations indicate that many independent samplings of the population would yield values of the estimator coefficients, a_i, which are expected to follow the "t" distribution for small sample sizes. "t" values may be computed from the sample information and compared with t distribution tables to test statistical hypotheses regarding specified relationships between the regressor variables and the response variable.[13]

In this study the computed t value simply expresses a ratio between the central tendency of the relation, i.e., the estimated coefficient, and its variability, measured by the standard deviation of the estimated regression coefficient. The computed t values, positive or negative, indicate the reliability that can be placed in an estimated value of Y, based on the estimated coefficient and the given values of X. The acceptance or rejection of a null hypothesis, e.g., $a_1 = 0$, is based on a comparison of computed t values with the critical values from a t distribution table for specified sample sizes and confidence levels.[14]

All the variables in the selected model are statistical significant at the 95 percent level. Although the true parameters are unknown, it can be inferred that the true parameter is expected to be within the interval, $a \pm t_{.025}(s)$, about 95 percent of the time.[15] The term

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[13] David S. Huang, Regression and Econometric Methods, New York, 1970.

[14] Ibid.

[15] Ibid.

"true parameter" must be cautiously interpreted where multicollinearity is a problem. Although the regression coefficients may be reliable for prediction purposes, no particular significance should be attached to the estimated regression coefficients since collinearity in the data seriously limits the specification of the model and the estimation of the "true" coefficients.[16]

The computed F value, 209.23, is not very useful in evaluating the equation since it merely indicates that the model is highly significant and warrants the rejection of the null hypothesis. It is not to be inferred from this statement that the F statistic is not an important one. Rather, since the F statistic is related to the t test, $\bar{R}^2$ and Se, the latter statistics provide alternative measures which are more useful in interpreting the significance or effectiveness of the selected model.[17]

The adjusted coefficient of determination, $\bar{R}^2 = 0.95$, simply indicates that the regression equation accounts for, or "explains", about 95 percent of the variation in sale price. Or alternatively, the standard error of estimate, Se = ca. \$1380, implies that about two-thirds of the observed sale prices are expected to be within ± \$1380 of the estimated sale prices. Both measures suggest that the model is effective, given the premises and assumptions of the study.[18]

Although the "vital" statistics are encouraging, one must be very cautious in interpreting the effectiveness of the model. Several comments should help put the model into perspective.

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[16] Ibid.

[17] Carl F. Christ, Econometric Models and Methods, New York, 1966.

[18] Mordecai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis, 3d ed., New York, 1963.

1. The model is static, i.e., it is based on the premise that the forces influencing the level and structure of prices are relatively stable. These forces are however dynamic and must be eventually incorporated into a modified model, or the choice of variables and estimates of the parameters periodically re-determined.
2. The model is based on a defined population, and a particular range of X_i values. Precarious results are obtained if these limitations are not observed.
3. Multicollinearity is a serious problem. Structural questions have not been answered by the model. The choice of variables and the specified relations are in many cases discretionary, i.e., several alternative models could have been chosen. The selected model does not necessarily represent the "best" solution to the problem; rather it is considered to be acceptable in view of the selection criteria.
4. The ultimate test of a predictive model is pragmatic, i.e., will it predict or forecast reliable estimates. Although the preliminary tests (to be discussed later) were encouraging, the efficacy of the model must be evaluated in light of operational results.

Prediction and Forecasting

The main purpose of most regression models is prediction and forecasting. As noted by Huang there are two important assumptions underlying statistical prediction and forecasting, viz., that the model realistically describes the behavior of the system, and that the structure of the model remains relatively stable over the projection period.[19]

A conceptual distinction is usually drawn between prediction and forecasting. The former involves estimating the expected or mean value of the response variable, while forecasting refers to the projection of a single value of Y.[20] Prediction involves estimating a point on the regression surface - which represent the expected or mean value of Y, given the values of X_1, X_2, ... X_n. Errors of prediction are due to errors in estimating the parameters - given of course that the assumptions of the model are correct.

The predicted values of Y for the observations in the sample used to construct the model are calculated and plotted against the actual sale prices in Appendix E. A confidence interval could be constructed around the predicted values, and would be expected to have a probability of say 0.95 of bracketing the true values. Tax assessors would primarily be concerned with prediction since their objective is to estimate some average or mean value of Y.

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[19] David S. Huang, Regression and Econometric Methods, New York, 1970.

[20] Ibid.

The fee appraiser on the other hand is usually concerned with forecasting individual values of Y. Although the point estimate is the same, the confidence interval is wider when forecasting.[21] In addition to errors in estimating the parameters, the variance of the error term must also be considered. In sum, the variability of a single value of Y is attributable to two variances, and both must be allowed for when constructing confidence intervals for the forecasted values of Y.

Verification of the Model

The ultimate verification of the model must be based on operational results. However, a number of tests may be conducted to give a preliminary verification of the model. A critical test of the validity of an equation or model is its ability to predict "extra-sample" observation values.[22] In other words, the equation is tested by using the estimated coefficients to predict or forecast values of Y for observations not used in the estimation and construction of the predictive model.

The model in this study was tested by using extra-sample observations. The parameters of the model were estimated by using all October, 1970, through March, 1971, observations in the defined population. The model was tested by collecting data on all April transactions in the defined population and predicting the expected sale price, based on the previously estimated parameters and given the X_{ij} values of the 23 "new" observations. The results of the test are summarized in Table II.

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[21] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

[22] Carl F. Christ, Econometric Models and Methods, New York, 1966.

The computed mean value of the residuals was ca. $400, while the expected value was zero, based on the assumptions of the model. This implies that there may have been an upward trend in actual sale prices which was not accounted for by the static model. This would not be an unexpected occurrence, and emphasizes the need to control and maintain the model, as discussed later. On the other hand, about 70 percent of the actual sale prices were within one standard error of the estimate of the predicted sale price, which is the expected result (68%) based on the assumptions of the model. An overall analysis of the extra sample residuals suggests that the model forecasted acceptable results.

Another procedure is to test the stability of the estimated regression coefficients, a_i, over the sample space.[23] Two dimensions of the sample space were tested, viz., time and area.

The impact of time on the stability of the estimated parameters is of critical importance since the main purpose of the model is to predict or forecast over some time space. The sample was split into two batches, each covering a three-month period.[24] The quarterly

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[23] Ibid.

[24] David S. Huang, Regression and Econometric Methods, New York, 1970.

Table II - Actual and Predicted Sale Prices, Computed and Graphed, for the Extra-Sample Observations, Based on the Estimated Regression Coefficients for the Selected Model.

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ACTUAL      PREDICTED                      PERCENT *                 RANGE = 12,000 TO 48,000                  *
 VALUE        VALUE             RESIDUAL    ERROR  *                                                           *
  (A)          (P)                                 *                 SCALE = 620.7 PER COLUMN                  *
                                                   *                                                           *
15000.0      17062.6       -2062.6      -13.7      *     A  P                                                  *
15000.0      14230.0         769.9        5.1      *    PA                                                     *
15400.0      16533.0       -1133.0       -7.3      *     A P                                                   *
16000.0      16306.8        -306.8       -1.9      *      AP                                                   *
16600.0      17068.8        -468.8       -2.8      *       AP                                                  *
16800.0      16798.3           1.6         .0      *        P                                                  *
16800.0      16911.8        -111.8        -.6      *        P                                                  *
17000.0      16050.0         949.9        5.5      *       PA                                                  *
18000.0      17458.9         541.0        3.0      *         PA                                                *
18200.0      18954.9        -754.9       -4.1      *          AP                                               *
18500.0      20294.4       -1794.4       -9.6      *          A  P                                             *
20000.0      19785.8         214.1        1.0      *             P                                             *
21000.0      21086.4         -86.4        -.4      *               P                                           *
22000.0      24442.7       -2442.7      -11.1      *                A   P                                      *
22500.0      21104.2        1395.7        6.2      *               P A                                         *
24500.0      24056.6         443.3        1.8      *                   PA                                      *
26000.0      22902.5        3097.4       11.9      *                  P    A                                   *
27500.0      26629.0         870.9        3.1      *                        PA                                 *
30000.0      29072.9         927.0        3.0      *                            PA                             *
32500.0      31024.6        1475.3        4.5      *                               P A                         *
33250.0      33620.9        -370.9       -1.1      *                                  AP                       *
35500.0      31438.3        4061.6       11.4      *                               P      A                    *
40300.0      38299.8        2000.1        4.9      *                                          P   A            *
40300.0      38299.8        2000.1        4.9      *                                          P   A            *
```

regression coefficients were computed, and are compared to the pooled coefficients, i.e., those estimated in the final model. The estimated coefficients, with the respective computed t value (in parentheses), are summarized in Table III.

An analysis of Table III seems to warrant two outstanding conclusions. First, those variables with high t values in the pooled sample appear to be relatively stable, while those with low t values are not very stable. And secondly, the standard error of the estimate, Se, and the adjusted coefficient of determination, $\overline{R}^2$, remain at about the same level in all time periods.

The seemly contradictory conclusions dramatize the problem of multicollinearity and underscores the warning issued earlier about the interpretation of the results. The regression model may be reliable for predictive purposes, but questions of a structural nature can not be answered.[25] It would appear at first blush that the use of the first quarter coefficients to predict the values of Y for the observations in the second quarter would yield unreliable and erroneous estimates since the values of some of the coefficients changed sharply. This conclusion does not necessarily follow since there may have been a realignment of coefficient values, with the effects netting out for predictive purposes. In other words, one variable may "rob" another of its influence and statistical significance, but the common influence of the two variables may not be lost from the equation.[26]

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[25] Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

[26] Ibid.

Table III - Quarterly and Pooled Regression Equation Coefficients for Estimating the Sale Price of Single Family Residences in the Defined Housing Market[a]

Regressor[b]	4th. Qtr., 1970	1st. Qtr., 1971	Pooled[c]
QUNBLA	7.99 (11.62)[d]	6.64 (7.43)	7.22 (13.22)
QUNAUX	5.59 (2.85)	-1.20 (-0.33)	3.82 (2.20)
QULINX	73.97 (4.69)	91.63 (4.37)	79.63 (6.24)
AGEIMP	-101.53 (-3.15)	-209.25 (-5.35)	-174.57 (-7.25)
LOTSIZ	0.04 (0.60)	0.25 (2.32)	0.17 (3.21)
SITE 2	89.01 (0.28)	1156.52 (2.92)	745.87 (2.93)
NEIQL 2	2498.55 (4.22)	1300.20 (1.83)	1156.38 (2.97)
NEIQL 3	6434.70 (6.17)	4220.55 (4.17)	4214.57 (6.68)
NEIQL 4	8635.61 (7.95)	7798.11 (5.89)	7433.98 (9.21)
DISTUF	-1573.86 (-3.37)	-2045.28 (-3.84)	-1666.36 (-4.69)
DTUFSQ	137.37 (3.28)	153.46 (3.18)	126.47 (4.01)
DISTMP	962.92 (2.43)	1154.61 (2.09)	1133.58 (3.59)
DTMPSQ	-54.04 (-2.64)	-63.04 (-2.16)	-64.52 (-3.91)
AREA W	-214.08 (-0.41)	1302.13 (1.76)	817.13 (2.03)

Table III (continued)

Se^e	1158.55	1498.83	1379.84
$\bar{R}^{2\,f}$	0.9524	0.9498	0.9474
n^g	86	77	163

[a] See Chapter I, *The Data*, for definition of market.

[b] Definitions of the regressors are found in Table I.

[c] These are the estimated coefficients for the selected model. All pooled coefficients are significant at the 5 percent level by conventional test.

[d] Computed t value. See: William J. Fraser, Jr., *The Demand for Money*, New York, 1967, for a glossary of statistical terms.

[e] Standard error of estimate for the equation.

[f] Coefficient of multiple determination, corrected for degrees of freedom.

[g] Number of observations.

The stability of the coefficients over the sample space was further tested with respect to geographic area. The estimated area and pooled regression coefficients, with relevant statistics, are presented in Table IV. As was the case when the sample was split by quarters, the regressors with high t values tend to be more stable, as is expected, than those with low t value.

Although structural conclusions are precarious at best, an analysis of the results seems to suggest that we are dealing with two populations. In the East, there are not enough neighborhoods rated 3 and 4 to derive at a reliable estimate for these regressors. Further, since the sample space is split with respect to area, it is reasonable to expect that the estimated parameters for the distance variables, viz., DISTUF, DISTUF^2, DISTMP and DISTMP^2, may have changed. The stability of the distance variables in the time-split of the sample space (Table III) vis-a-vis their instability in the area-split seems to lend credence to this point.

Finally, the low $\overline{R}^2$ of 0.65 indicates that substantial variations in sale price in the East have not been "accounted for" by the regression equation. However the low standard error of estimate, Se, is expected since there were smaller total variations in actual sales prices in the East vis-a-vis the West. A high percentage of the low-priced houses are located in the East including most of the "FHA 235" low-income housing. With due respect for the "distorting" effects of multicollinearity on the estimated parameters - the evidence seems to imply that the sample space encompasses at least two populations. Those who are familiar with the Gainesville housing market would probably agree with this contention.

Table IV - Area and Pooled Regression Equation Coefficients for Estimating the Sale Price of Single Family Residences in the Defined Housing Market[a]

Regressor	East	West	Pooled
QUNBLA	6.43	7.39	7.22
	(10.31)	(7.76)	(13.22)
QUNAUX	11.53	-1.78	3.82
	(6.05)	(-0.60)	(2.20)
QULINX	40.99	93.87	79.63
	(1.85)	(3.57)	(6.24)
AGEIMP	-148.11	-192.88	-174.57
	(-3.87)	(-4.78)	(-7.25)
LOTSIZ	0.16	0.24	0.17
	(2.59)	(2.36)	(3.21)
SITE 2	529.44	561.39	745.87
	(2.01)	(1.08)	(2.93)
NEIQL 2	765.53	1791.90	1156.38
	(1.80)	(2.19)	(2.97)
NEIQL 3	(b)	5076.19	4214.57
		(4.77)	(6.68)
NEIQL 4	(b)	8130.13	7433.98
		(5.96)	(9.21)
DISTUF	-1023.35	-2767.50	-1666.36
	(-1.00)	(-2.71)	(-4.69)
DTUFSQ	107.68	243.05	126.47
	(1.20)	(2.19)	(4.01)
DISTMP	1101.54	1499.35	1133.58
	(2.29)	(2.06)	(3.59)
DTMPSQ	-55.27	-89.57	-64.52
	(-2.58)	(-2.06)	(-3.91)
AREA W	(c)	(c)	817.13
			(2.03)

Table IV (continued)

Se	951.10	1710.38	1379.84
$\bar{R}^2$	0.6553	0.9394	0.9474
n	94	69	163

[a] See Table III footnotes.

[b] There were only several observations rated NEIQL 3 and none rated NEIQL 4 in the EAST. Since this was not a sufficient number of observations to provide a reliable estimate of the coefficient for NEIQL 3, the several properties were rated NEIQL 2 and no estimates were computed for the two regressors.

[c] No regression coefficients were estimated for AREA W since area was the basis for splitting the sample space.

A key question now appears to be whether or not the populations can be combined, and the difference accounted for by a dummy variable. The evidence generated by these models, and discussions in the literature on dummy variables, suggest that this may be a justifiable use of the dummy. Wonnacott and Wonnacott note that the use of the dummy presumes that the slopes of the regression surfaces are equal, i.e., the use of the dummy simply results in a vertical shift of the regression surface.[27] Although this requires an additional prior restriction, the use of the dummy may be justified since only one function, rather than several, would need to be fitted to the data, thereby reducing the number of observations required for a given degree of freedom.

Table IV yields an interesting statistic. The pooled $\overline{R}^2$ is higher than either of the $\overline{R}^2$'s for the batch samples. This is an important statistic since it is a measure of the effectiveness of the pooled model in accounting for total variations in sale price. It is also significant to note that the t value for AREA W is significant at the 95 percent level. Appendix G also reveals that if the AREA W regressor is deleted from the model, there would be some reduction in the pooled $\overline{R}^2$ and an increase in the standard error of the estimate, Se.

The objectives of the study, such as high $\overline{R}^2$, low Se and significant t values, would seem to warrant the inclusion of a dummy variable for AREA W in the selected model. This use of the dummy would appear to be justified when the cost of information is considered, as fewer observations are required to estimate the parameters - given specified degrees of freedom. In sum, the pooled sample, using a dummy to partially "account for" area differences, appears to yield satisfactory results in this particular model, and has certain advantages which seem to justify its use.

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[27] Ibid.

Test of the Assumptions of the Model

A preliminary verification requires that the assumptions of the model be tested. An examination of the classical regression model indicates that the three assumptions are related to the distribution of the residuals, i.e., $e_i = Y_i - \hat{Y}_i$, where Y_i is an observed value of Y and $\hat{Y}_i$ is the estimated value of Y based on the regression equation.[28] Thus an examination of residuals provides an appropriate test of the assumptions.[29]

See Appendix F for plots of the residuals, e_i, against computed sale price (i.e., the regression surface) and all regressors in the selected model. In view of the significance of the time space, the residuals were also plotted against sale dates (using recording date as a surrogate) of the respective observations. In addition, see Appendix E for a plot of actual versus predicted sale prices. The plot has been ordered according to actual sale to facilitate interpretation.

The assumptions of the model are usually not confirmed by an analysis of the residuals. Rather, the absence of an abnormal pattern would not warrant a denial of the assumptions.[30] A roughly horizontal band through the plots, centered on zero, tends to indicate an absence of abnormality. A systematic pattern of residuals away from zero, a curvilinear tendency, or a change in variability over the range of observations would cast doubt on the validity of the assumptions.[31]

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[28] N.R. Draper and H. Smith, Applied Regression Analysis, New York, 1966.

[29] Ibid.

An examination of the plots in Appendix F would seem to imply that there is correlation among the residuals - which would be a violation of the assumption that the Y_i values are independent - since "runs" of residuals may be found above and below the regression surface over the range of values. This pattern of the residuals is presumably attributable to the presence of dummy variables which, in this model, causes a periodic vertical shift of the regression surface as "new" dummy variables influence price, e.g., moving from NEIQL 2 to NEIQL 3. Thus the residuals are expected to "drift" through the regression surface between changes in dummy variables; otherwise the $E(e_i) = 0$ assumption would be violated, i.e., presumably such a pattern is inherent when dummies are used. The independent Y_i assumption does not appear to be suspect.

An overall examination of the residuals, including those obtained from testing the model against "new" observations (Table II), does not seem to warrant a denial of the assumptions of the model. The absence of any systematic trends in the residuals generally implies that the regression equation provides an acceptable fit of the data, i.e., there is little evidence that significant variables have been omitted from the model.[32]

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[30] Ibid.

[31] Ibid.

[32] Ibid.

Maintenance of the Model

The urban residential housing market is dynamic, while the "selected" model is static. Thus the model is not expected to yield reliable estimates over time unless some procedure is established for maintaining the model. Two broad approaches to the problem appear feasible.

First, a control procedure could be established to detect systematic changes in the effectiveness of the model. The key barometer of effectiveness is expected to be changes in the pattern of deviations between actual and predicted values, i.e., $Y_i - \hat{Y}_i$. A monitoring of this residual and various plot patterns - such as plot of residuals against the X_i regressors, time, and other variables which appear to be relevant - would indicate whether or not the model continues to "fit" the data.[33] When warranted, the model could be modified by "re-fitting" the equations to appropriate data.

A second procedure would be to develop a dynamic model by incorporating time-series variables into the estimating equation to account for systematic changes in the level and structure of sale prices, such as those attributable to seasonality, trends, cyclical patterns and long-run changes in the market structure.[34] Although a dynamic model would also need to be controlled to assure reliable results, the implications of such a model are far reaching - assuming of course that one can be feasibly developed.

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[33] Ibid.

[34] David S. Huang, Regression and Econometric Methods, New York, 1970.

In sum, a procedure must be established to control and maintain the effectiveness of the predictive model. Operational experience and research may provide acceptable solutions to the problem.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary of the Research

Replication of results and objectivity are hallmarks of scientific methodology.[1] One leading real estate academician has emphatically stated, and others apparently agree, that appraising is an art, not a science.[2] Although the term scientific may unfortunately be misunderstood to connote the methods and precision of the physical sciences, a thesis of this inquiry is that the scientific approach can, and should, characterize the appraisal process and methodology.

A scientific approach to real estate appraising need not conjure images of unrealistic and dogmatic applications of mathematical and statistical techniques. The position taken in this investigation is that science may be defined as a systematic method of analysis that facilitates the accumulation of reliable knowledge.[3]

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[1] For example, see George C. Homans, The Nature of Social Science, New York, 1967; F.S.C. Northrop, The Logic of the Sciences and the Humanities, New York, 1967; and Murray Sidman, Tactics of Scientific Research, New York, 1960.

[2] Paul F. Wendt, Real Estate Appraisal: A Critical Analysis of Theory and Practice, New York, 1956.

[3] Carlos L. Lastrucci, The Scientific Approach: Basic Principles of the Scientific Method, Cambridge, Mass., 1967.

The feasibility of applying scientific methodology to appraising has been suggested by a number of writers and empirical studies.[4] The need for such an approach is manifested by the inconsistent replication of solutions to appraisal problems, and the paucity of accumulated reliable knowledge regarding the factors influencing real estate values and the nature of the relationships.[5] The efficacy of conventional appraisal practice has been seriously questioned on theoretical grounds by a number of leading real estate academicians.[6] A major contention of this study is that the manifested weaknesses of conventional appraisal practice, namely, inconsistent replication of results and the lack of reliable knowledge regarding value relationships, is mainly attributable to the form of logical argument.

A careful examination of appraisal literature and practice reveals that the predominant, if not exclusive, type of logical argument used to establish the reliability of the value inference is the compound analogy.[7] This procedure is generally acknowledged to be a precarious form of logical argument in empirical inquiry.[8] The strength of the argument, and the reliability of the inference, are functions of the number of basic analogues, the nature and extent of the characteristics shared by the basic and derivative analogues, and the degree of disparity between the analogues.[9] The small number of basic analogues conventionally used in appraisal problems and the great heterogeneity of the real estate product suggest why the compound analogy frequently yields unreliable value inferences.

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[4] See: Edward F. Renshaw, "Scientific Appraisal," National Tax Journal, XI, No. 4, 1958; Irving F. Davis, Jr., "A Scientific Approach to Real Estate Appraisal," Journal of the American Society of Farm Managers and Rural Appraisers, XXVIII, February, 1964, and William C. Pendleton, Jr., "Statistical Inference in Appraisal and Assessment," The Appraisal Journal, XXXIII, January, 1965.

[5] Richard U. Ratcliff, "Real Estate Valuation and Highway Condemnation Awards," Wisconsin Commerce Reports, University of Wisconsin at Madison, 1966, Vol. VII, No. 6.

[6] See: Richard U. Ratcliff, "A Restatement of Appraisal Theory," Wisconsin Commerce Reports, University of Wisconsing at Madison, 1963, Vol. VII, No. 1; and Paul F. Wendt, Real Estate Appraisal: A Critical Analysis of Theory and Practice, New York, 1956.

[7] American Institute of Real Estate Appraisers, The Appraisal of Real Estate, Chicago, 1967.

This study is based on the inductive argument, which differs basically from the compound analogy in that the former leads to a generalization about a defined universe, while the latter infers a singular conclusion.[10] This shift in emphasis from singular to general conclusions is an important one in scientific inquiry since it permits the accumulation of reliable knowledge about phenomena. This does not appear to be widely appreciated by the appraisal fraternity: reliable knowledge about the factors and relationships affecting value and price determination should enable appraisers to infer conclusions which can be consistently replicated.

The fundamental appraisal problem dealt with in this study is how to explain the level and structure of prices in a defined urban residential market. To guide the inquiry, a theory of urban residential price determination was postulated, namely:

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[8] See: Maylon H. Hepp, Thinking Things Through: An Introduction to Logic, New York, 1956; and Irving M. Copi, Introduction to Logic, 2d ed., New York, 1961.

[9] Ibid.

[10] Ibid.

> exchange ratios (price and market value) are determined by a bargaining process between a finite number of buyers and sellers of a heterogeneous product in a dynamic environment, with the price of a particular property being a function of: product specification; subjective valuations; past, present and expected future exchange ratios of the subject and substitute properties; past, present and expected future levels and elasticities of supply and demand; dynamic environmental factors; information system; and interaction of buyers and sellers.

The basic purpose of the inquiry was not to tentatively confirm the theory of market behavior, but rather to investigate the plausibility and feasibility of a model to predict and forecast urban residential sale prices with an acceptable degree of reliability and effectiveness. Since the appraiser does not determine value but merely seeks to measure it, the appraisal process should be a model of the market mechanism to the extent feasible. This is the simulation approach recommended by Professor Ratcliff.[11] Or the appraisal model can seek to identify the relevant variables influencing price determination and measure their effect, which is the approach in this study.

It was noted that the urban residential housing market appears to be characterized by a bilateral oligopoly structure. Since the development of a simulation model of market behavior seems to be an enormous, if not impossible, task, the approach taken was to: limit the scope of the study to a major segement of the housing market (i.e., extremely heterogeneous properties below and above the $15,000 to $45,000 range were excluded); assume that the level and elasticities of supply and demand are relatively stable in the short-run (say three months); relate the structure of prices to a product specification system, and assume that the indeterminancy of price due to the bargaining process, behavioral differences, imperfections of the information system, etc., could be incorporated into the model as a normally distributed random variable.

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[11] Richard U. Ratcliff, "Real Estate Valuation and Highway Condemnation Awards," Wisconsin Commerce Reports, University of Wisconsin at Madison, 1966, Vol. VII, No. 6.

A major hypothesis tested was that:

$$\hat{Y} = f\ (X_i + e \ / S, D, K_i)$$

where:

$\hat{Y}$ = expected or probable urban residential sale price in the specified market in the time period under consideration

X_i = dimensions of the product (specification), namely, improvements, site, neighborhood and location, which are expected to significantly influence the expected utility to be derived from the consumption of urban housing

e = error term, which was assumed to be normally distributed with a zero mean and standard deviation

$/S, D, K_i$ = given supply and demand conditions and other market factors, i.e., these were assumed to be relatively stable during the period under investigation.

The preceding hypothesis, which appears to be consistent with the postulated theory, was tested by deducing from it a large number of statistical hypotheses which could be empirically tested. The data for the test was based on a sample of 163 observations from the Gainesville, Florida, housing market during the period October 1, 1970, to March 31, 1971. All transactions during the period were included in the sample if they were in the defined universe. The sample comprised about 70 percent of all transactions in the October through March period, and would appear to provide a substantive test of the main hypothesis.

Surrogate variables for improvement, site, neighborhood and location were postulated as statistical hypotheses, and tested in a classical linear regression model, using least squares estimating techniques, as follows:

$$\hat{Y} = a_o + a_1X_1 + a_2X_2 + \ldots + a_nX_n + e$$

where:

$\hat{Y}$ and e = defined in the postulated main hypothesis

a_i = estimated regression coefficients or parameter estimators

X_i = regressors or predictor variables, including those based on transformed non-linear functions.

The choice of the final model was guided by specified selection criteria and the use of a combination of selection procedures in order to minimize model specification errors due to the multicollinearity in the data problem. Most of the variables, excluding the dummies, were tested as linear and non-linear functions. The selection of the type of function to be included in the final model was based on consistency with economic propositions, empirical "fit", and simplicity. All the variables in the non-linear functions were transformed before the parameters were estimated so that a first-order linear regression equation could be used.

The variables in the selected model were number of square feet (S.F.) in the basic living area, S.F. in the auxiliary components of the improvement, quality of construction index, chronological age of improvement, S.F. in the lot, extent of site facilities (dummy), neighborhood rating (dummies), distance from the University (quadratic function), distance from the adverse influence of heavy manufacturing (quadratic), and a dummy "area of the city" variable. All relations were statistically significant at the 95 percent confidence level based on t tests of the null hypotheses. The adjusted coefficient of determination was ($\bar{R}^2$=) 0.95, and the standard error of the estimate for the equation was (S_e=) $1380.

The results of the empirical model must be cautiously interpreted because of the collinear nature of the data in the urban residential market. Most writers agree that, given the multicollinearity problem, the estimated values of the parameters and the particular choice of variables included in the equation are precarious at best.[12] Thus the model provides little, if any, reliable knowledge regarding the "true" nature of the relationships affecting price determination and the structure of the market.

On the other hand, most writers also agree that the ability of the model to reliably predict variations in the response variable may not be adversely affected by the multicollinearity problem if no attempt is made to use the data out of its collinear context.[13] The statistical significance of the variables, high adjusted coefficient of determination, and low standard error of the estimate for the equation are encouraging in this respect.

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[12] See: David S. Huang, Regression and Econometric Methods, New York, 1970; and Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, New York, 1970.

The ultimate verification of the model must be based on long-term operational results. However a number of tests did provide a preliminary verification of the model. The equation predicted acceptable results for 23 extra-sample observations, which were not used in the estimation of the parameters of the model. This is usually considered to be a critical test of the model.[14]

A second series of tests were "run" to determine the stability of the estimated regression coefficients over the sample space, namely, time and geographic area. While some of the estimated parameters were relatively stable, others were unstable. However the "vital" statistics for predictive purposes, namely, the standard error of the estimate and the adjusted coefficient of determination, continued to yield acceptable results over the sample space. This seemingly contradictory model performance is believed to be attributable to the multicollinearity problem, with the changing values of the unstable parameters "netting out" for prediction purposes.

Another verification of the model involved a test of the assumptions, namely, that e_i ($= Y_i - \hat{Y}_i$) is a statistically independent normally distributed random variable, the expected mean of the residuals (e_i) is zero and the residuals have a standard deviation.[15] An examination of the residuals[16] plotted against actual sale price, the X_i regressors, and a time variable reveals no abnormalities, except a drift of the actual sale prices through the regression surface at periodic intervals, which is presumably attributable to the use of dummy variables since these cause vertical shifts of the surface as higher-valued dummies influence the equation.

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[13] Ibid.

[14] Carl F. Christ, Econometric Models and Methods, New York, 1966.

In sum, an examination of the residuals does not seem to reveal any unexplained abnormalities which would warrant a denial of the assumptions of the model. The absence of any systematic trends in the residuals also suggests that the regression equation "fits" the data reasonably well, i.e., there is little evidence that significant variables have been omitted from the model.

Generalizations Based on the Investigation

The results of the study seem to warrant the following broad generalizations.

1. The basic appraisal problem in the urban residential market is how to explain the level and structure of prices in a market which appears to be characterized by a bilateral oligopoly structure.

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[15] David S. Huang, Regression and Econometric Methods, New York, 1970.

[16] N.R. Draper and H. Smith, Applied Regression Analysis, New York, 1966.

2. The efficacy of current appraisal practice has been questioned on methodological grounds, namely, the compound analogy type of logical argument has a number of fundamental weaknesses which limit the reliability of the value inference.
3. A scientific approach to appraising and the use of an inductive argument may permit the accumulation of reliable knowledge about price-value relationships in the residential market.
4. The specification of the model appears to be consistent with the postulated theory of market behavior, and the results seem to tentatively affirm (i.e., the results do not appear to warrant a denial) the hypothesis that expected sale price is a function of improvements, site, neighborhood and location, given that supply and demand conditions and other market factors remain relatively constant.
5. The inquiry provides little reliable knowledge about the "true" parameters of the specified relations due to the collinearity in the data problem; but the high coefficient of determination and low standard error of the estimate for the equation tentatively suggest that a predictive regression model of price determination is plausible and presumably feasible.
6. The methodology, research procedure, postulated theory of market behavior, and the main hypothesis are expected to be generally applicable to other residential markets.

However, the model is localized due to the nature of the real estate market; hence a "new" model or models will have to be developed for each specified urban residential market.

7. The model is static, and thus a procedure must be established to control and maintain an acceptable performance standard. This will require that the model be periodically re-specified and "new" parameters estimated, or the eventual development of a dynamic model (which of course would also need to be controlled).

Synopsis of Research Suggested by the Study

The following areas of research appear to be suggested by the investigation.

1. To further verify the methodology, predictive models similar to the one in this study need to be developed for other cities. This should include testing alternative hypotheses, functional relations, and an extension of the model to the entire urban residential market. Importantly, these models need to be operationally tested, and the findings shared with the appraisal community in order to facilitate the accumulation of reliable knowledge.
2. The various indices, such as neighborhood and quality of construction, need to be intensively and extensively

examined. Preliminary research results, which were not reported in the study, suggest that alternative rating systems may increase the reliability of the indices and reduce the cost of information.

3. Models using other research techniques need to be investigated, such as multivariate regression and systems of simultaneous equations. The purpose of such studies would be mainly to improve the specification of the model and increase knowledge about the structure of the market by seeking to cope with the multicollinearity problem. This would complement the research with univariate regression models, such as the one investigated in this study.
4. The plausibility and feasibility of a dynamic model need to be investigated. This requires research with relevant time series data and the eventual development of a predictive model which incorporates both cross-sectional and time series variables. This may be a formidable task, but the far-reaching implications of such a model definitely seem to warrant research in this area.
5. Little reliable knowledge is known about the behavioral aspects of urban residential price determination, such as the determinants of subjective valuations, the nature of the bargaining process, the role and impact of the information system (broadly defined to include appraisers, brokers, lenders, etc.). Research in these areas seems warranted.

6. All of the preceding generalizations regarding research apply equally to the development of complementary predictive models for other classes of real property, such as a "land" model and an "income" property appraisal model.

The development of reliable predictive models would have important implications for institutional appraisers, e.g., tax assessors and lenders, fee appraisers, and urban planners. And importantly from a societal view, the efficient allocation and utilization of scarce resources are predicated on the notion that alternatives are available and can be rationally evaluated, which presupposes that the economic goods in question can be reliably valued or priced. The enormous stock of wealth in the form of real property certainly seems to warrant intensive and extensive research in real estate appraisal methodology.

APPENDIX A

Acronym, Functional Form, Source and Description of Variables That Appear in the Appendices

Acronym	Functional Form	Source
SALEPR	Dependent variable	Owner
EXTWAL	Linear	Assessor's records
CABMIL	Linear	Assessor's records
FLOFIN	Linear	Assessor's records
INTFIN	Linear	Assessor's records
HTGAIR	Linear	Assessor's records
PLUMBG	Linear	Assessor's records
QULINX	Linear	Assessor's records
SHAPEF	Linear	Assessor's records
SIZEFA	Linear	Assessor's records
QUNBLA	Linear	Assessor's records
QUNAUX	Linear	Assessor's records
QUNIMP	Linear	Assessor's records
EXTRAF	Linear	Assessor's records
AGEIMP	Linear	Assessor's records

Appendix A (extended)

Description
Actual sale price
Rating[a]: Exterior wall
Rating[a]: Cabinet & millwork
Rating[a]: Floor finish
Rating[a]: Interior finish
Rating[a]: Heating / air conditioning
Rating[a]: Plumbing fixtures
Rating[a] for overall quality of construction; summation of ratings for components of improvements, e.g., exterior walls; thirteen components comprise total rating system.
Rating[a] for number of corners in building.
Rating[a] for size of basic living area, scale based on the notion of diminishing marginal costs, i.e., the larger the basic living area, the lower the cost of construction per square foot, cet. par.
Quantity of square feet in the basic living area, i.e., excluding garage, patio, etc.
Adjusted quantity of square feet in the auxiliary areas of the improvements, e.g., garage, patio, etc.; the total square feet in each component was adjusted by a rating system[a] based on differences in cost of construction per square foot of the respective components.
QUNBLA + QUNAUX
Total dollar value of extra features, e.g., fireplace, intercom, fences, etc.; the amount assigned to each extra feature is based on a fixed valuation for that item[a], i.e., each item is treated as a dummy variable with a fixed coefficient value.
The chronological age of the improvement.

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[a] The tax assessor's ratings are based on the contracted "Howze-A-Matic System", developed by Howze and Associates, Inc., 3013 Horatio Street, Tampa, Florida.

Appendix A (continued)

Acronym	Functional Form	Source
LOTSIZ	Linear	Tax Maps
EXQLIX	Exponential → Linear	Transformation
EXQBLA	Exponential → Linear	Transformation
EXQAUX	Exponential → Linear	Transformation
EXPAGE	Exponential → Linear	Transformation
EXPLOT	Exponential → Linear	Transformation
DISTMS	Linear	City map and zoning map
DISTMP	Linear	City map and zoning map
DISTUF	Linear	Tax map and index map
DISTCB	Linear	Tax map and index map
DTMSSQ	2nd. order → 1st. order	Transformation
DTMPSQ	2nd. order → 1st. order	Transformation
DTUFSQ	2nd. order → 1st. order	Transformation
DTCBSQ	2nd. order → 1st. order	Transformation
DTMPCU	3rd. order → 1st. order	Transformation
DTUFCU	3rd. order → 1st. order	Transformation
EXDTMP	Exponential → Linear	Transformation
EXDTUF	Exponential → Linear	Transformation
DISTMP + DTMPSQ	Quadratic function using first order regressors	Maps (DISTMP) Transformation (DTMPSQ)

Appendix A (extended)

Description
The quantity (size) of the lot in total number of square feet.
QULINX as an exponential function; the original X_i values were transformed to permit the use of a linear function in the estimating equation.
QUNBLA: exponential → linear
QUNAUX: exponential → linear
AGEIMP: exponential → linear
LOTSIZ: exponential → linear
Distance from center of tax map (¼ section) in which observation is situated to nearest area zoned "MS", i.e., light manufacturing, measured linearly between the points.
Distance to "MP" zoning, heavy manufacturing, measured as above.
Distance from tax map in which observation is situated to the University of Florida main campus, measured at right angles. The distance value was based on the number of ¼ mile units (tax maps) between the two points, derived from an index (tax) map of the city.
Distance to CBD, central business district, measured as above.
$(\mathrm{DISTMS})^2$; the X_i values were transformed to permit the use of a first-order linear function in the estimating equation.
$(\mathrm{DISTMP})^2$; transformed, as above.
$(\mathrm{DISTUF})^2$; transformed, as above.
$(\mathrm{DISTCB})^2$; transformed, as above.
$(\mathrm{DISTMP})^3$; transformed, as above.
$(\mathrm{DISTUF})^3$; transformed, as above.
DISTMP as an exponential function; transformed, as above.
DISTUF as an exponential function; transformed, as above.
Quadratic function for DISTMP; the function enters the equation as first-order regressors by transformation, as above.

Appendix A (continued)

Acronym	Functional Form	Source
DISTUF + DTUFSQ	Quadratic function using first-order regressors	Maps (DISTMP) Transformation (DTMPSQ)
DISTMP + DTMPSQ + DTMPCU	Cubic function using first-order regressors	Maps (DISTMP) Transformation (DTMPSQ) Transformation
DISTUF + DTUFSQ + DTUFCU	Cubic function using first-order regressors	Maps (DISTMP) Transformation (DTMPSQ) Transformation
NEIQL 2 NEIQL 3 NEIQL 4 (due to limitations on the scope of the study, no observations were rated NEIQL 0; and NEIQL 1 was dropped from the estimating equation to avoid linear dependency.)	Dummies: same functional form as the constant term, i.e., changes intercept value.	The neighborhoods were rated by observation, published sources (e.g., neighborhood analysis, planning unit study, zoning maps, deed restrictions, etc.) and by discussions with persons who are active in the local real estate market. The task of rating each property is not as time consuming as might be expected since most observations in the same neighborhood have the same rating. A few properties on the fringe of a neighborhood of course may have a higher or lower rating, depending on the influence of adjacent areas.

Appendix A (extended)

Description

Quadratic function for DISTUF; transformed, as above.

Cubic function for DISTMP; transformed, as above.

Cubic function for DISTUF; transformed, as above.

A modal rating was assigned to each observation based on the following neighborhood characteristics.

Quality of neighborhood (rating)	Excell. (4)	Good (3)	Ave. (2)	Fair (1)	Poor (0)
Prestige & reputation	___	___	___	___	___
General confidence in future devel. & character	___	___	___	___	___
Protection against inharmonious uses via zoning & deed restrictions, adequacy of buffer zones	___	___	___	___	___
Safety from danger of creeping blight, encroachment of incompatible land uses, and changes in the demographic structure	___	___	___	___	___
Homogeneity re: price range, type & quality of construction, styling, age of structures, occupation, income and demographic structure	___	___	___	___	___
Neighborhood trends re: average property values, land use, occupancy, types of housing units, pop. density, vacancies, demographic structure, income & occupation of residents, occupancy	___	___	___	___	___
Physical & social attractiveness, freedom from adverse physical & social influences, level of property maintenance, owner occupancy appeal	___	___	___	___	___

Appendix A (continued)

Acronym	Functional Form	Source
SITE 2 (for reasons above, no observations were rated SITE 0, and SITE 1 was dropped to avoid linear dependency)	Dummy	Observation and published sources, as above
TOPO 2 TOPO 3 (TOPO 0, 1, 4 were statistically insignificant, and were not included in the run of key equations since the program could not handle over 50 variables)	Dummies	Observation and published sources (e.g., physiographic survey), as above
AREA W (AREA E dropped to avoid linear dependency)	Dummy	City map
NEW 01 (NEW 00 dropped, as above)	Dummy	Owner (also assessor's records)
F235-0 (F235-1, as above)	Dummy	Owner (also recorded mortgage)
SOIL 0 (SOIL 1, as above)	Dummy	Soil suitability map based on physiographic survey
DATE	Linear	Recording date stamped on deed of record

Appendix A (extended)

Description	
Special amenities, e.g., nearness to schools, shopping & recreational facilities	___ ___ ___ ___ ___
General marketability of neighborhood, owner appeal, freedom from nuisances, etc.	___ ___ ___ ___ ___
Quality of neighborhood index (modal rating)	___
Site facilities and utility connections: (most = 2, adeq. = 1, few = 0) re: street paving, sidewalk, curb, storm drains, city water, city gas, city sanitary sewer, street lights, telephone, cable TV, fire hydrant nearby.	___
Topographical features: (excellent = 4, good = 3, average = 2, fair = 1, poor = 0) re: subject to flooding, drainage, soil perculation, landscaping, lot shape, grade, contour, general attractiveness, special amenities (e.g., view of features of natural beauty), freedom from nuisances (e.g., heavy traffic, intersection, limited access, etc.) and nature of immediate surroundings (lots and houses).	___

The city was delineated by Main Street into AREA E and AREA W.

The property was rated NEW 01, if constructed since January, 1970. (NEW 00, conversely)

If the purchase was not financed under the FHA 235 program, the property was designated F235-0. (F235-1, conversely)

The SOIL-0 rating was assigned if the observation property was not subject to flooding by standing water during summer months following intensive storms. (SOIL-1, conversely)

A scale from 1 to 180 was established and matched with a corresponding recording date. The observation was then assigned a value from the scale

Appendix A (continued)

Acronym	Functional Form	Source
87	Linear	Assessor's Records
872	Linear	Assessor's Records
8723	Linear	Assessor's Records
87234	Linear	Assessor's Records
872345	Linear	Assessor's Records

Appendix A (extended)

Description
The ratings for PLUMBG and HTGAIR were added to form a single regressor.
PLUMBG + HTGAIR + EXTWAL, as above.
PLUMBG + HTGAIR + EXTWAL + CABMIL
PLUMBG + HTGAIR + EXTWAL + CABMIL + FLOFIN
PLUMBG + HTGAIR + EXTWAL + CABMIL + FLOFIN + INTFIN

APPENDIX B

Abridged Computer Print-out of Data Matrix and Correlation Matrix for Variables That Appear in the Appendices, Based on Program ECON[a]

Data Code[b]

X_1 = SALEPR
X_2 = EXTWAL
X_3 = CABMIL
X_4 = FLOFIN
X_5 = INTFIN
X_6 = DTCBSQ
X_7 = HTGAIR
X_8 = PLUMBG
X_9 = DTMSSQ
X_{10} = QUNIMP
X_{11} = QULINX
X_{12} = EXQBLA
X_{13} = SHAPEF
X_{14} = SIZEFA
X_{15} = QUNBLA
X_{16} = AGEIMP
X_{17} = DTUFSQ

X_{18} = NEW 01
X_{19} = F235 0
X_{20} = DTMPSQ
X_{21} = DISTMS
X_{22} = DISTMP
X_{23} = DISTCB
X_{24} = DISTUF
X_{25} = EXQAUX
X_{26} = AREA W
X_{27} = EXQLIX
X_{28} = NEIQL 2
X_{29} = NEIQL 3
X_{30} = NEIQL 4
X_{31} = DTUFCU
X_{32} = DTMPCU
X_{33} = LOTSIZ
X_{34} = EXPAGE

X_{35} = SITE 2
X_{36} = EXPLOT
X_{37} = TOPO 2
X_{38} = TOPO 3
X_{39} = QUNAUX
X_{40} = EXTRAF
X_{41} = SOIL 0
X_{42} = 872
X_{43} = 8723
X_{44} = 87234
X_{45} = 872345
X_{46} = 87
X_{47} = EXDTUF
X_{48} = EXDTMP
X_{49} = DATE
X_{50} = 1

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[a] The original ECON regression program was written by Mr. M.R. Norman of M.I.T.

[b] See Appendix A for description of each variable or acronym.

Data Matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
115000.00	16.00	7.00	8.00	17.00	25.00	2.00	10.00	121.00	1417.00	101.00	3.12	104.00	100.00	1137.00	25.00
215000.00	16.00	7.00	5.00	17.00	49.00	5.00	13.00	1.00	1052.00	102.00	2.62	102.00	101.00	962.00	5.00
315000.00	16.00	7.00	5.00	14.00	36.00	5.00	11.00	9.00	1199.00	97.00	3.00	102.00	100.00	1098.00	11.00
415000.00	16.00	7.00	2.00	14.00	36.00	5.00	11.00	9.00	998.00	94.00	2.46	100.00	101.00	900.00	7.00
515200.00	16.00	7.00	5.00	14.00	36.00	5.00	11.00	9.00	1107.00	97.00	2.62	100.00	101.00	962.00	11.00

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 615200.00  16.00  7.00   5.00  14.00   36.00   5.00  13.00    4.00 1049.00  100.00   2.59  102.00  101.00  918.00   9.00
 715300.00  16.00  7.00   5.00  17.00   35.00  12.00  11.00    4.00 1404.00  107.00   3.56  102.00   99.00 1270.00  10.00
 815400.00  16.00  7.00   5.00  14.00  103.00   5.00  14.00  256.00 1132.00  100.00   2.79  100.00  100.00 1025.00   7.00
 915400.00  16.00  7.00   2.00  17.00   35.00  12.00  14.00    4.00 1205.00  107.00   2.98  100.00  100.00 1092.00  10.00
1015500.00  16.00  7.00   5.00  14.00  100.00   5.00  13.00  256.00 1353.00   99.00   3.08  100.00  100.00 1125.00  11.00
1115500.00  16.00  7.00   8.00  17.00   25.00   2.00  10.00  121.00 1236.00  106.00   2.58  102.00  101.00  936.00  21.00
1215500.00  16.00  7.00   5.00  17.00   49.00   5.00  11.00    1.00 1060.00  100.00   2.55  102.00  101.00  936.00   5.00
1315500.00  16.00  7.00   5.00  14.00   15.00   5.00  13.00   25.00 1204.00  106.00   3.09  102.00  100.00 1127.00   0.0
1415500.00  16.00  7.00   2.00  17.00   15.00   5.00  13.00   25.00 1154.00   99.00   2.87  100.00  100.00 1053.00  12.00
1515500.00  16.00  7.00   5.00  17.00   15.00   2.00  13.00   36.00 1131.00  100.00   2.85  104.00  100.00 1045.00  12.00
1615600.00  16.00  7.00   8.00  17.00   15.00   2.00  12.00    9.00 1198.00  100.00   2.79  100.00  100.00 1025.00  15.00
1715700.00  16.00  7.00   5.00  14.00   16.00   5.00  11.00   25.00 1171.00  102.00   2.95  100.00  100.00 1086.00   0.0
1915700.00  16.00  7.00  13.00  14.00   36.00   5.00  11.00    4.00  971.00  105.00   2.59  102.00  101.00  953.00   0.0
1915800.00  16.00  7.00   5.00  17.00   81.00   5.00  13.00   25.00 1232.00  102.00   3.05  100.00  100.00 1118.00  10.00
2015900.00  16.00  7.00   2.00  19.00   36.00   2.00  10.00    4.00 1399.00   96.00   3.91  104.00   99.00 1364.00  17.00
2116000.00  16.00  7.00   2.00  17.00    9.00   2.00  14.00   25.00 1326.00  100.00   2.49  100.00  101.00  912.00  15.00
2216000.00  16.00  7.00   8.00  17.00   15.00   4.00  10.00    9.00 1462.00  105.00   3.84  106.00   99.00 1345.00  17.00
2316000.00  16.00  7.00   5.00  17.00   23.00   4.00  13.00   16.00 1149.00  101.00   2.82  102.00  100.00 1035.00  10.00
2416040.00  16.00  7.00   9.00  17.00   25.00   2.00  12.00   16.00 1316.00  104.00   3.32  104.00   99.00 1200.00  13.00
2516050.00  16.00  7.00  13.00  14.00   36.00   5.00  11.00    4.00  971.00  105.00   2.59  102.00  101.00  953.00   0.0
2516100.00  16.00  7.00   2.00  14.00   35.00   5.00  12.00    9.00 1259.00   95.00   3.15  100.00  100.00 1152.00   6.00
2716116.00  16.00  7.00   5.00  14.00   35.00   5.00  13.00    4.00 1237.00   99.00   3.02  100.00  100.00 1105.00   6.00
2816200.00  16.00  7.00   5.00  14.00   49.00  12.00  14.00    1.00 1095.00  107.00   2.82  100.00  100.00 1035.00   5.00
2916200.00  16.00  7.00   5.00  17.00   49.00   5.00  13.00   16.00 1164.00  102.00   3.00  100.00  100.00 1100.00   5.00
3016250.00  16.00  7.00   7.00  19.00   25.00   2.00  11.00    4.00 1588.00  104.00   3.83  102.00   99.00 1343.00   0.0
3116300.00  20.00  7.00   5.00  14.00   16.00   5.00  13.00   25.00 1180.00  108.00   3.02  102.00  100.00 1105.00   0.0
3216300.00  16.00  7.00   5.00  14.00   15.00   5.00  13.00   25.00 1164.00  104.00   2.95  102.00  100.00 1091.00   0.0
3316300.00  16.00  7.00  13.00  14.00   49.00   5.00  14.00    1.00 1043.00  108.00   2.49  100.00  101.00  912.00   0.0
3416300.00  16.00  7.00   5.00  14.00   16.00   5.00  13.00   25.00 1246.00  106.00   3.09  102.00  100.00 1127.00   0.0
3516400.00  20.00  7.00   5.00  14.00   15.00   5.00  13.00   25.00 1180.00  108.00   3.02  102.00  100.00 1105.00   0.0
3616500.00  26.00  7.00   5.00  14.00   16.00   5.00  13.00   25.00 1218.00  112.00   3.00  100.00  100.00 1099.00   0.0
3716500.00  16.00  7.00   5.00  17.00   35.00   5.00  11.00    9.00 1124.00  100.00   2.75  104.00  100.00 1010.00  11.00
3316500.00  16.00  7.00   2.00  14.00   35.00   5.00  11.00    9.00 1100.00   94.00   2.62  100.00  101.00  952.00   9.00
3916500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.69  102.00  101.00  989.00   0.0
4016500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1060.00  107.00   2.59  102.00  101.00  989.00   0.0
4115500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.69  102.00  101.00  989.00   0.0
4216500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.59  102.00  101.00  989.00   0.0
4316500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.69  102.00  101.00  989.00   0.0
4416500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.69  102.00  101.00  989.00   0.0
4516500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1037.00  105.00   2.69  102.00  101.00  989.00   0.0
4616500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  109.00   2.69  102.00  101.00  989.00   0.0
4716500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1059.00  107.00   2.69  102.00  101.00  989.00   0.0
4816500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1037.00  105.00   2.69  102.00  101.00  989.00   0.0
4916500.00  16.00  7.00  13.00  14.00   49.00   5.00  11.00   16.00 1037.00  105.00   2.59  102.00  101.00  989.00   0.0
5016500.00  26.00  7.00   5.00  14.00   15.00   5.00  13.00   25.00 1218.00  114.00   3.00  100.00  100.00 1099.00   0.0
5116500.00  26.00  7.00   5.00  14.00   15.00   5.00  13.00   25.00 1246.00  114.00   3.09  102.00  100.00 1127.00   0.0
5216600.00  16.00  7.00   5.00  14.00   35.00   4.00  13.00   16.00 1142.00   99.00   2.65  100.00  101.00  975.00   0.0
5316600.00  18.00  7.00   5.00  14.00   36.00   4.00  13.00   16.00 1093.00  101.00   2.55  100.00  101.00  936.00   0.0
5416750.00  16.00  7.00   8.00  17.00   16.00   2.00  13.00    9.00 1215.00  105.00   3.24  100.00  100.00 1175.00  15.00
5516800.00  16.00  7.00   8.00  17.00   81.00   5.00  11.00  289.00 1393.00  106.00   3.55  108.00   99.00 1266.00  12.00
5516900.00  16.00  7.00   2.00  14.00   35.00   5.00  14.00    4.00 1121.00   97.00   2.79  100.00  100.00 1025.00   6.00
5717100.00  16.00  7.00  13.00  14.00   35.00   5.00  13.00    4.00 1069.00  107.00   2.59  100.00  101.00  952.00   0.0
5817200.00  16.00  7.00   5.00  14.00   81.00   5.00  14.00  289.00 1165.00  102.00   2.93  100.00  100.00 1075.00   6.00
5917200.00  16.00  7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  107.00   2.59  100.00  101.00  952.00   0.0
6017200.00  16.00  7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  109.00   2.59  100.00  101.00  952.00   0.0
6117208.00  16.00  7.00   2.00  14.00   36.00   5.00  10.00    9.00 1525.00   93.00   4.12  102.00   98.00 1416.00   8.00
6217300.00  18.00  7.00   5.00  14.00   35.00   4.00  12.00   16.00 1231.00  100.00   3.14  100.00  100.00 1143.00   0.0
6317300.00  18.00  7.00   5.00  14.00   35.00   4.00  10.00   16.00 1373.00   94.00   3.67  100.00   99.00 1300.00   0.0
6417300.00  16.00  7.00  13.00  14.00   49.00   5.00  13.00   16.00 1062.00  109.00   2.59  100.00  101.00  952.00   0.0
6517300.00  16.00  7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  109.00   2.59  100.00  101.00  952.00   0.0
6517300.00  16.00  7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  109.00   2.59  100.00  101.00  952.00   0.0
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 6717300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  109.00    2.59  100.00  101.00  952.00    0.0
 6817300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1038.00  107.00    2.59  100.00  101.00  952.00    0.0
 6917300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1085.00  107.00    2.59  100.00  101.00  952.00    0.0
 7017300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  111.00    2.59  100.00  101.00  952.00    0.0
 7117300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1069.00  109.00    2.59  100.00  101.00  952.00    0.0
 7217300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1038.00  107.00    2.59  100.00  101.00  952.00    0.0
 7317300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1038.00  107.00    2.59  100.00  101.00  952.00    0.0
 7417300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00   16.00 1038.00  107.00    2.59  100.00  101.00  952.00    0.0
 7517300.00   16.00   7.00   2.00  14.00   35.00   5.00  14.00    4.00 1135.00   97.00    2.79  100.00  100.00 1025.00    6.00
 7617500.00   16.00   7.00   5.00  14.00   49.00   5.00  14.00    1.00 1095.00  100.00    2.82  100.00  100.00 1035.00    5.00
 7717500.00   16.00   7.00   2.00  14.00   35.00   5.00  10.00    9.00 1570.00   93.00    4.22  102.00   98.00 1441.00    7.00
 7817700.00   16.00   7.00   5.00  14.00   16.00   5.00  11.00   25.00 1407.00  102.00    3.63  100.00   99.00 1290.00    0.0
 7917700.00   16.00   7.00   5.00  14.00   16.00   5.00  10.00   25.00 1378.00  101.00    3.54  100.00   99.00 1265.00    0.0
 8017700.00   16.00   7.00   5.00  14.00   16.00   5.00  11.00   25.00 1407.00  104.00    3.63  102.00   99.00 1290.00    0.0
 8117750.00   16.00   7.00   5.00  14.00  100.00   5.00  11.00  256.00 1540.00   97.00    3.69  102.00   99.00 1305.00   10.00
 8217375.00   16.00   7.00   5.00  14.00   36.00  12.00  13.00    4.00 1275.00  106.00    3.16  100.00  100.00 1150.00    5.00
 8319000.00   16.00   7.00   8.00  14.00   49.00   5.00  14.00  225.00 1197.00  107.00    2.98  102.00  100.00 1057.00   13.00
 9418000.00   16.00   7.00   8.00  17.00   16.00   2.00  10.00    9.00 1898.00  100.00    6.14  108.00   96.00 1815.00   20.00
 8518100.00   16.00   7.00  13.00  14.00   49.00   5.00  14.00    1.00 1224.00  110.00    2.93  100.00  100.00 1075.00    0.0
 8518100.00   16.00   7.00  13.00  14.00   49.00   5.00  11.00    1.00 1291.00  107.00    3.33  100.00   99.00 1202.00    0.0
 8718100.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00    1.00 1274.00  107.00    3.26  100.00  100.00 1132.00    0.0
 8818500.00   16.00   8.00   5.00  14.00   81.00   5.00  11.00  289.00 1410.00  101.00    3.71  108.00   99.00 1310.00    9.00
 8918500.00   16.00   7.00   5.00  14.00   49.00   5.00  12.00   16.00 1262.00   98.00    3.15  100.00  100.00 1152.00    6.00
 9018600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1346.00  106.00    3.50  102.00   99.00 1252.00    0.0
 9118600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1345.00  106.00    3.50  102.00   99.00 1252.00    0.0
 9218600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1347.00  106.00    3.50  102.00   99.00 1252.00    0.0
 9318600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1347.00  106.00    3.50  102.00   99.00 1252.00    0.0
 9418600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1328.00  104.00    3.50  100.00   99.00 1252.00    0.0
 9518600.00   15.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1328.00  104.00    3.50  100.00   99.00 1252.00    0.0
 9618600.00   16.00   7.00  13.00  14.00   49.00   5.00  10.00   16.00 1347.00  106.00    3.50  102.00   99.00 1252.00    0.0
 9719000.00   16.00   7.00   5.00  14.00   49.00   5.00   9.00   16.00 1769.00   95.00    5.22  106.00   97.00 1653.00    6.00
 9819200.00   16.00   7.00   5.00  17.00   49.00   5.00  14.00    1.00 1293.00  110.00    2.93  100.00  100.00 1075.00    6.00
 9919300.00   16.00   7.00  13.00  14.00   49.00   5.00  13.00    1.00 1304.00  107.00    3.24  100.00  100.00 1175.00    0.0
10019500.00   16.00   7.00   2.00  17.00   25.00   4.00  12.00   81.00 1279.00   97.00    3.23  100.00  100.00 1172.00   17.00
10119700.00   16.00   7.00   8.00  17.00   81.00   4.00  11.00  289.00 1455.00  105.00    3.47  100.00   99.00 1244.00   13.00
10219800.00   16.00   7.00   5.00  14.00  100.00   5.00  13.00  256.00 1239.00  101.00    3.19  102.00  100.00 1131.00    5.00
10320000.00   16.00   7.00   8.00  19.00   35.00   5.00  10.00  121.00 1829.00  103.00    4.95  102.00   98.00 1599.00   13.00
10420400.00   20.00   7.00   5.00  14.00   35.00   5.00  13.00    4.00 1227.00  103.00    3.06  100.00  100.00 1118.00    6.00
10520500.00   26.00   7.00   5.00  14.00   81.00  12.00  13.00   25.00 1350.00  117.00    3.28  100.00  100.00 1139.00    3.00
10620500.00   16.00   7.00   5.00  14.00   35.00   5.00  11.00    9.00 1496.00   99.00    3.48  100.00   99.00 1248.00    2.00
10720500.00   26.00   7.00   8.00  14.00   25.00   5.00  11.00    4.00 1443.00  111.00    3.86  100.00   99.00 1350.00    6.00
10820817.00   16.00   7.00   5.00  14.00   81.00  12.00  11.00  196.00 1558.00  107.00    3.83  100.00   99.00 1344.00    5.00
10921000.00   16.00   7.00   8.00  14.00   81.00  12.00  11.00  289.00 1346.00  110.00    3.34  100.00   99.00 1205.00   14.00
11021000.00   16.00   7.00   5.00  17.00  100.00   5.00  10.00  256.00 1779.00   99.00    4.13  100.00   98.00 1419.00   11.00
11121000.00   15.00   7.00  10.00  14.00   35.00  12.00  10.00    9.00 1703.00  111.00    4.06  102.00   98.00 1402.00    2.00
11221000.00   16.00   7.00   2.00  17.00   15.00  12.00  10.00   81.00 1521.00  111.00    4.03  104.00   99.00 1395.00   23.00
11321000.00   16.00   7.00   5.00  17.00   16.00   2.00  13.00    9.00 1546.00  102.00    3.22  100.00  100.00 1170.00   13.00
11421250.00   16.00   7.00   8.00  17.00   81.00   5.00  11.00  196.00 1760.00  107.00    4.57  100.00   98.00 1519.00    5.00
11521500.00   26.00   7.00   8.00  17.00   25.00   2.00   9.00  121.00 1910.00  112.00    5.00  110.00   97.00 1609.00   25.00
11621500.00   16.00   7.00   2.00  14.00   49.00  12.00  11.00   16.00 1546.00  101.00    3.99  102.00   99.00 1334.00    6.00
11721500.00   16.00   7.00   8.00  17.00   15.00  12.00  11.00   81.00 1574.00  119.00    4.40  102.00   98.00 1492.00   16.00
11821500.00   16.00   7.00  13.00  14.00   15.00  12.00  14.00   25.00 1303.00  120.00    3.24  104.00  100.00 1177.00    0.0
11921667.00   16.00   7.00   5.00  14.00   81.00  12.00   9.00  196.00 1807.00  105.00    5.34  102.00   97.00 1676.00    5.00
12022000.00   16.00   7.00   5.00  14.00  100.00  12.00  12.00  256.00 1392.00  107.00    3.77  102.00   99.00 1328.00    2.00
12122000.00   16.00   7.00  13.00  14.00   81.00  12.00  14.00   25.00 1348.00  120.00    3.22  100.00  100.00 1170.00    0.0
12222100.00   16.00   7.00   2.00  14.00   49.00   5.00   9.00   16.00 1753.00   92.00    5.12  106.00   97.00 1633.00    6.00
12322500.00   16.00   7.00   5.00  14.00   81.00   5.00  13.00  289.00 1292.00   99.00    3.25  104.00  100.00 1130.00    9.00
12422500.00   16.00   7.00   8.00  17.00   35.00  12.00  11.00  121.00 1444.00  114.00    3.72  102.00   99.00 1315.00   10.00
12522500.00   18.00   7.00   8.00  17.00   25.00   2.00  10.00   81.00 1548.00  104.00    4.34  108.00   98.00 1468.00   20.00
12622733.00   16.00   7.00   8.00  14.00    4.00   5.00  11.00   16.00 1650.00  100.00    4.68  104.00   98.00 1543.00    4.00
12722900.00   16.00   7.00  10.00  14.00  100.00  12.00  12.00  256.00 1523.00  115.00    3.83  100.00   99.00 1344.00    0.0
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12823000.00    16.00     7.00     8.00    17.00    81.00     5.00     9.00   196.00 2061.00   105.00     5.80   104.00    97.00 1758.00     8.00
12923000.00    16.00     7.00     5.00    14.00    49.00    12.00    10.00   225.00 1626.00   103.00     4.71   100.00    98.00 1550.00     5.00
13023000.00    16.00     7.00    10.00    14.00    49.00    12.00    13.00    49.00 1540.00   116.00     3.62   102.00    99.00 1286.00     0.0
13123500.00    26.00     7.00     8.00    17.00    15.00    12.00    10.00   100.00 1699.00   126.00     4.52   102.00    98.00 1509.00    28.00
13223500.00    16.00     8.00     8.00    17.00    25.00    12.00    11.00    81.00 1863.00   119.00     4.04   108.00    99.00 1396.00    10.00
13323750.00    16.00     8.00    13.00    14.00    81.00    12.00    14.00    25.00 1282.00   121.00     3.16   104.00   100.00 1150.00     0.0
13423800.00    16.00     8.00    10.00    14.00    49.00    12.00    11.00    49.00 1659.00   115.00     4.46   102.00    98.00 1495.00     2.00
13525000.00    16.00     8.00    11.00    17.00    15.00    12.00    10.00    81.00 1884.00   121.00     4.60   102.00    98.00 1525.00    21.00
13625700.00    16.00     7.00     8.00    17.00    15.00     2.00    10.00    81.00 1505.00   106.00     3.92   110.00    99.00 1366.00    23.00
13725800.00    16.00     7.00    10.00    14.00    49.00    12.00     9.00    49.00 1862.00   114.00     5.41   100.00    97.00 1688.00     0.0
13826000.00    28.00     7.00     8.00    17.00    49.00     5.00    10.00   225.00 2007.00   120.00     6.43   108.00    96.00 1861.00     5.00
13926500.00    16.00     7.00     5.00    14.00    81.00    12.00    10.00   196.00 1654.00   108.00     4.07   100.00    98.00 1404.00     0.0
14026600.00    16.00     7.00    13.00    14.00   100.00    12.00    11.00   256.00 1693.00   117.00     4.10   104.00    98.00 1410.00     1.00
14126700.00    16.00     7.00    10.00    14.00    81.00    12.00     9.00   289.00 1808.00   110.00     5.31   102.00    97.00 1653.00     1.00
14227100.00    26.00     7.00     5.00    14.00    81.00    12.00    10.00   196.00 1689.00   118.00     4.54   102.00    98.00 1514.00     0.0
14327500.00    28.00     7.00     8.00    17.00    49.00     5.00     9.00   225.00 2334.00   116.00     8.77   104.00    95.00 2171.00     5.00
14428000.00    16.00     8.00    13.00    14.00    81.00    12.00     9.00   289.00 1942.00   116.00     5.92   102.00    97.00 1779.00     0.0
14528100.00    16.00     7.00     8.00    17.00    25.00     4.00    10.00    81.00 2083.00   107.00     6.58   102.00    96.00 1894.00    21.00
14529000.00    16.00     8.00     5.00    17.00    36.00    12.00     9.00   144.00 1900.00   107.00     5.55   106.00    97.00 1714.00    12.00
14730000.00    16.00     7.00     8.00    14.00    49.00    12.00    10.00   169.00 1954.00   113.00     6.07   102.00    96.00 1803.00     3.00
14830000.00    16.00     8.00     8.00    14.00    36.00    12.00     9.00    81.00 1869.00   111.00     5.48   102.00    97.00 1702.00     0.0
14931000.00    16.00     7.00     8.00    14.00    35.00    12.00     9.00   196.00 2269.00   109.00     8.18   108.00    95.00 2102.00     9.00
15031500.00    20.00     8.00     8.00    17.00    36.00    12.00    11.00    81.00 1749.00   121.00     4.85   102.00    98.00 1590.00     5.00
15132000.00    16.00     8.00    10.00    14.00    49.00    12.00     9.00   169.00 2260.00   109.00     7.78   102.00    95.00 2051.00     6.00
15232500.00    16.00     7.00    13.00    14.00    35.00    12.00    10.00    81.00 2113.00   118.00     6.12   104.00    95.00 1912.00     2.00
15333000.00    15.00     7.00    10.00    14.00    35.00    12.00    10.00    81.00 2216.00   112.00     6.69   102.00    96.00 1900.00     2.00
15435000.00    16.00     8.00    10.00    14.00    36.00    12.00     9.00   196.00 2338.00   115.00     7.45   104.00    95.00 2000.00     1.00
15535000.00    16.00     8.00    10.00    14.00    35.00    12.00     9.00    81.00 2258.00   115.00     7.45   102.00    95.00 2009.00     1.00
15635000.00    16.00     8.00    10.00    14.00    36.00    12.00    10.00    81.00 2271.00   113.00     7.24   102.00    96.00 1980.00     1.00
15736000.00    16.00     8.00    10.00    14.00    49.00    12.00     9.00   169.00 2280.00   111.00     7.85   102.00    95.00 2050.00     1.00
15837000.00    16.00     8.00     7.00    14.00    36.00    12.00     9.00    81.00 2355.00   110.00     8.44   104.00    95.00 2133.00     1.00
15937500.00    20.00     7.00    13.00    14.00    35.00    12.00     9.00    81.00 2416.00   119.00     8.58   102.00    95.00 2150.00     2.00
16038000.00    20.00     7.00    13.00    14.00    49.00    12.00    10.00   100.00 2132.00   122.00     6.49   100.00    96.00 1870.00     0.0
16138000.00    16.00     8.00     8.00    17.00    15.00    12.00     9.00   100.00 2675.00   113.00    11.94   110.00    95.00 2480.00    15.00
16241000.00    28.00     8.00    13.00    17.00    35.00    12.00     9.00    81.00 2613.00   127.00    10.57   106.00    95.00 2358.00     2.00
16343000.00    16.00     8.00    10.00    14.00    36.00    12.00    10.00    81.00 2998.00   116.00    15.99   102.00    94.00 2772.00     0.0

           17       18       19       20       21       22       23       24       25       26       27       28       29       30       31       32
 1       9.00      0.0     1.00    81.00    11.00     9.00     5.00     3.00    16.44     1.00     2.75      0.0      0.0      0.0    27.00   729.00
 2      81.00      0.0     1.00    16.00     1.00     4.00     7.00     9.00     2.46      0.0     2.77      0.0      0.0      0.0   729.00    64.00
 3      64.00      0.0     1.00    36.00     3.00     6.00     6.00     8.00     2.75      0.0     2.64     1.00      0.0      0.0   512.00   216.00
 4      64.00      0.0     1.00    36.00     3.00     6.00     6.00     8.00     2.66      0.0     2.56      0.0      0.0      0.0   512.00   216.00
 5      64.00      0.0     1.00    36.00     3.00     6.00     6.00     8.00     4.26      0.0     2.64      0.0      0.0      0.0   512.00   216.00
 6      64.00      0.0     1.00    36.00     2.00     5.00     6.00     8.00     3.71      0.0     2.72      0.0      0.0      0.0   512.00   216.00
 7      64.00      0.0     1.00    36.00     2.00     5.00     6.00     8.00     3.82      0.0     2.92      0.0      0.0      0.0   512.00   216.00
 8      64.00      0.0     1.00   196.00    16.00    14.00    10.00     8.00     2.92     1.00     2.72      0.0      0.0      0.0   512.00  2744.00
 9      64.00      0.0     1.00    36.00     2.00     6.00     6.00     8.00     3.10      0.0     2.92      0.0      0.0      0.0   512.00   216.00
10      64.00      0.0     1.00   196.00    16.00    14.00    10.00     8.00     9.78     1.00     2.69     1.00      0.0      0.0   512.00  2744.00
11       9.00      0.0     1.00    81.00    11.00     9.00     5.00     3.00    12.18     1.00     2.89      0.0      0.0      0.0    27.00   729.00
12      81.00      0.0     1.00    16.00     1.00     4.00     7.00     9.00     3.46      0.0     2.72      0.0      0.0      0.0   729.00    64.00
13      36.00     1.00      0.0   196.00     5.00    14.00     4.00     6.00     2.16      0.0     2.89      0.0      0.0      0.0   216.00  2744.00
14      36.00      0.0     1.00   100.00     5.00    10.00     4.00     6.00     2.75      0.0     2.69      0.0      0.0      0.0   216.00  1000.00
15      36.00      0.0     1.00    81.00     6.00     9.00     4.00     6.00     2.34      0.0     2.72      0.0      0.0      0.0   216.00   729.00
16      36.00      0.0     1.00    81.00     3.00     9.00     4.00     6.00     5.64      0.0     2.72     1.00      0.0      0.0   216.00   729.00
17      36.00     1.00      0.0   196.00     5.00    14.00     4.00     6.00     2.34      0.0     2.77      0.0      0.0      0.0   216.00  2744.00
18      64.00     1.00      0.0    36.00     2.00     6.00     6.00     8.00     1.20      0.0     2.86      0.0      0.0      0.0   512.00   216.00
19      49.00      0.0     1.00    25.00     5.00     5.00     9.00     7.00     3.13     1.00     2.77      0.0      0.0      0.0   343.00   125.00
20      36.00      0.0     1.00     9.00     2.00     3.00     6.00     6.00     1.42     1.00     2.61      0.0      0.0      0.0   216.00    27.00
21      25.00      0.0     1.00   121.00     5.00    11.00     3.00     5.00    62.80      0.0     2.72      0.0      0.0      0.0   125.00  1331.00
22      36.00      0.0     1.00    81.00     3.00     9.00     4.00     6.00     3.22      0.0     2.86      0.0      0.0      0.0   216.00   729.00
23      49.00      0.0     1.00    49.00     4.00     7.00     5.00     7.00     3.13      0.0     2.75      0.0      0.0      0.0   343.00   343.00
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24   49.00   0.0    1.00   49.00    4.00    7.00    5.00   7.00    3.19   0.0    2.83   1.00   0.0    0.0    343.00  343.00
25   64.00   1.00   0.0    36.00    2.00    5.00    6.00   8.00    1.20   0.0    2.86   0.0    0.0    0.0    512.00  216.00
26   64.00   0.0    1.00   36.00    3.00    5.00    6.00   8.00    2.92   0.0    2.59   0.0    0.0    0.0    512.00  216.00
27   64.00   0.0    1.00   36.00    2.00    5.00    6.00   8.00    3.74   0.0    2.69   0.0    0.0    0.0    512.00  216.00
28   81.00   0.0    1.00   16.00    1.00    4.00    7.00   9.00    1.82   0.0    2.92   0.0    0.0    0.0    729.00   64.00
29   25.00   0.0    1.00   16.00    4.00    4.00    7.00   5.00    1.90   1.00   2.77   0.0    0.0    0.0    125.00   64.00
30   49.00   0.0    1.00   16.00    2.00    4.00    5.00   7.00   11.59   1.00   2.83   0.0    0.0    0.0    343.00   64.00
31   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    2.12   0.0    2.94   0.0    0.0    0.0    216.00 2744.00
32   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    2.29   0.0    2.83   0.0    0.0    0.0    215.00 2744.00
33   81.00   1.00   0.0    16.00    1.00    4.00    7.00   9.00    3.71   0.0    2.94   0.0    0.0    0.0    729.00   64.00
34   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.29   0.0    2.89   0.0    0.0    0.0    216.00 2744.00
35   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    2.12   0.0    2.94   0.0    0.0    0.0    216.00 2744.00
36   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.29   0.0    3.06   0.0    0.0    0.0    216.00 2744.00
37   64.00   0.0    1.00   36.00    3.00    5.00    6.00   8.00    3.13   0.0    2.72   1.00   0.0    0.0    512.00  216.00
38   64.00   0.0    1.00   36.00    3.00    5.00    6.00   8.00    3.97   0.0    2.56   0.0    0.0    0.0    512.00  216.00
39   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
40   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.03   0.0    2.92   0.0    0.0    0.0    729.00  125.00
41   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
42   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
43   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
44   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
45   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    1.62   0.0    2.86   0.0    0.0    0.0    729.00  125.00
46   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.97   0.0    0.0    0.0    729.00  125.00
47   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.01   0.0    2.92   0.0    0.0    0.0    729.00  125.00
48   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    1.62   0.0    2.86   0.0    0.0    0.0    729.00  125.00
49   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    1.62   0.0    2.86   0.0    0.0    0.0    729.00  125.00
50   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.29   0.0    3.13   0.0    0.0    0.0    216.00 2744.00
51   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.29   0.0    3.13   0.0    0.0    0.0    216.00 2744.00
52   64.00   1.00   0.0    49.00    4.00    7.00    6.00   8.00    5.31   0.0    2.69   0.0    0.0    0.0    512.00  343.00
53   64.00   1.00   0.0    49.00    4.00    7.00    6.00   8.00    4.81   0.0    2.75   0.0    0.0    0.0    512.00  343.00
54   36.00   0.0    1.00   81.00    3.00    9.00    4.00   6.00    1.49   0.0    2.86   1.00   0.0    0.0    216.00  729.00
55   49.00   0.0    1.00  121.00   17.00   11.00    9.00   7.00    3.56   1.00   2.89   1.00   0.0    0.0    343.00 1331.00
56   64.00   0.0    1.00   36.00    2.00    5.00    6.00   8.00    2.61   0.0    2.64   0.0    0.0    0.0    512.00  216.00
57   64.00   1.00   0.0    36.00    2.00    5.00    6.00   8.00    3.22   0.0    2.92   0.0    0.0    0.0    512.00  216.00
58   49.00   0.0    1.00  121.00   17.00   11.00    9.00   7.00    2.46   1.00   2.77   0.0    0.0    0.0    343.00 1331.00
59   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
60   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
61   64.00   0.0    1.00   36.00    3.00    6.00    6.00   8.00    2.97   0.0    2.53   0.0    0.0    0.0    512.00  216.00
62   64.00   1.00   0.0    49.00    4.00    7.00    6.00   8.00    2.41   0.0    2.72   0.0    0.0    0.0    512.00  343.00
63   64.00   1.00   0.0    49.00    4.00    7.00    6.00   8.00    2.08   0.0    2.66   0.0    0.0    0.0    512.00  343.00
64   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.00   0.0    2.97   0.0    0.0    0.0    729.00  125.00
65   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
66   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
67   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
68   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.36   0.0    2.92   0.0    0.0    0.0    729.00  125.00
69   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.78   0.0    2.92   0.0    0.0    0.0    729.00  125.00
70   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    3.03   0.0    0.0    0.0    729.00  125.00
71   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    3.22   0.0    2.97   0.0    0.0    0.0    729.00  125.00
72   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.36   0.0    2.92   0.0    0.0    0.0    729.00  125.00
73   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.36   0.0    2.92   0.0    0.0    0.0    729.00  125.00
74   81.00   1.00   0.0    25.00    4.00    5.00    7.00   9.00    2.36   0.0    2.92   0.0    0.0    0.0    729.00  125.00
75   64.00   0.0    1.00   36.00    2.00    5.00    6.00   8.00    3.00   0.0    2.64   0.0    0.0    0.0    512.00  216.00
76   81.00   0.0    1.00   16.00    1.00    4.00    7.00   9.00    1.82   0.0    2.72   0.0    0.0    0.0    729.00   64.00
77   64.00   0.0    1.00   36.00    3.00    5.00    6.00   9.00    3.63   0.0    2.53   0.0    0.0    0.0    512.00  216.00
78   36.00   1.00   0.0   196.00    5.00   14.00    4.00   5.00    3.22   0.0    2.77   0.0    0.0    0.0    216.00 2744.00
79   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.10   0.0    2.75   0.0    0.0    0.0    216.00 2744.00
80   36.00   1.00   0.0   196.00    5.00   14.00    4.00   6.00    3.22   0.0    2.83   0.0    0.0    0.0    216.00 2744.00
81   64.00   0.0    1.00  196.00   16.00   14.00   10.00   8.00   10.49   1.00   2.64   1.00   0.0    0.0    512.00 2744.00
82   64.00   0.0    1.00   36.00    2.00    5.00    6.00   8.00    3.49   0.0    2.89   0.0    0.0    0.0    512.00  216.00
83   25.00   0.0    1.00   81.00   15.00    9.00    7.00   5.00    4.06   1.00   2.92   1.00   0.0    0.0    125.00  729.00
84   36.00   0.0    1.00   81.00    3.00    9.00    4.00   6.00    2.29   0.0    2.72   1.00   0.0    0.0    216.00  729.00
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85	81.00	1.00	0.0	16.00	1.00	4.00	7.00	9.00	4.44	0.0	3.00	0.0	0.0	0.0	729.00	64.00
86	81.00	1.00	0.0	16.00	1.00	4.00	7.00	9.00	2.44	0.0	2.92	0.0	0.0	0.0	729.00	64.00
87	81.00	1.00	0.0	16.00	1.00	4.00	7.00	9.00	2.51	0.0	2.92	0.0	0.0	0.0	729.00	64.00
88	49.00	0.0	1.00	121.00	17.00	11.00	9.00	7.00	2.72	1.00	2.75	1.00	0.0	0.0	343.00	1331.00
89	81.00	0.0	1.00	25.00	4.00	5.00	7.00	9.00	3.00	0.0	2.66	0.0	0.0	0.0	729.00	125.00
90	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.56	0.0	2.89	0.0	0.0	0.0	729.00	125.00
91	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.56	0.0	2.89	0.0	0.0	0.0	729.00	125.00
92	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.59	0.0	2.89	0.0	0.0	0.0	729.00	125.00
93	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.59	0.0	2.89	0.0	0.0	0.0	729.00	125.00
94	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.14	0.0	2.83	0.0	0.0	0.0	729.00	125.00
95	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.14	0.0	2.83	0.0	0.0	0.0	729.00	125.00
96	81.00	1.00	0.0	25.00	4.00	5.00	7.00	9.00	2.59	0.0	2.59	0.0	0.0	0.0	729.00	125.00
97	81.00	0.0	1.00	25.00	4.00	5.00	7.00	9.00	3.19	0.0	2.59	1.00	0.0	0.0	729.00	125.00
98	81.00	0.0	1.00	16.00	1.00	4.00	7.00	9.00	8.85	0.0	3.00	0.0	0.0	0.0	729.00	64.00
99	81.00	1.00	0.0	16.00	1.00	4.00	7.00	9.00	3.60	0.0	2.92	0.0	0.0	0.0	729.00	64.00
100	9.00	0.0	1.00	121.00	9.00	11.00	5.00	3.00	2.92	1.00	2.64	1.00	0.0	0.0	27.00	1331.00
101	49.00	0.0	1.00	121.00	17.00	11.00	9.00	7.00	8.25	1.00	2.86	1.00	0.0	0.0	343.00	1331.00
102	64.00	0.0	1.00	196.00	16.00	14.00	10.00	8.00	2.94	1.00	2.75	1.00	0.0	0.0	512.00	2744.00
103	16.00	0.0	1.00	121.00	11.00	11.00	6.00	4.00	9.97	1.00	2.80	1.00	0.0	0.0	64.00	1331.00
104	64.00	0.0	1.00	36.00	2.00	6.00	6.00	8.00	2.97	0.0	2.80	0.0	0.0	0.0	512.00	216.00
105	49.00	0.0	1.00	25.00	5.00	5.00	9.00	7.00	5.05	1.00	3.22	1.00	0.0	0.0	343.00	125.00
106	64.00	0.0	1.00	36.00	3.00	6.00	6.00	8.00	4.85	0.0	2.69	0.0	0.0	0.0	512.00	216.00
107	49.00	0.0	1.00	16.00	2.00	4.00	5.00	7.00	2.53	1.00	3.03	1.00	0.0	0.0	343.00	64.00
108	49.00	0.0	1.00	169.00	14.00	13.00	9.00	7.00	8.50	1.00	2.92	1.00	0.0	0.0	343.00	2197.00
109	49.00	0.0	1.00	121.00	17.00	11.00	9.00	7.00	4.06	1.00	3.00	1.00	0.0	0.0	343.00	1331.00
110	64.00	0.0	1.00	196.00	16.00	14.00	10.00	8.00	36.60	1.00	2.69	1.00	0.0	0.0	512.00	2744.00
111	64.00	0.0	1.00	36.00	3.00	6.00	6.00	8.00	20.29	0.0	3.03	0.0	0.0	0.0	512.00	216.00
112	4.00	0.0	1.00	121.00	9.00	11.00	4.00	2.00	3.53	1.00	3.03	1.00	0.0	0.0	8.00	1331.00
113	36.00	0.0	1.00	81.00	3.00	9.00	4.00	6.00	42.95	0.0	2.77	1.00	0.0	0.0	216.00	729.00
114	49.00	0.0	1.00	169.00	14.00	13.00	9.00	7.00	11.13	1.00	2.92	1.00	0.0	0.0	343.00	2197.00
115	9.00	0.0	1.00	81.00	11.00	9.00	5.00	3.00	20.29	1.00	3.06	0.0	1.00	0.0	27.00	729.00
116	81.00	0.0	1.00	25.00	4.00	5.00	7.00	9.00	5.05	0.0	2.75	0.0	0.0	0.0	729.00	125.00
117	4.00	0.0	1.00	121.00	9.00	11.00	4.00	2.00	2.51	1.00	3.29	1.00	0.0	0.0	8.00	1331.00
118	36.00	1.00	1.00	100.00	5.00	10.00	4.00	6.00	3.53	0.0	3.32	1.00	0.0	0.0	216.00	1000.00
119	49.00	0.0	1.00	169.00	14.00	13.00	9.00	7.00	3.71	1.00	2.86	1.00	0.0	0.0	343.00	2197.00
120	64.00	0.0	1.00	196.00	16.00	14.00	10.00	8.00	1.90	1.00	2.92	1.00	0.0	0.0	512.00	2744.00
121	49.00	1.00	1.00	25.00	5.00	5.00	9.00	7.00	5.93	1.00	3.32	0.0	0.0	0.0	343.00	125.00
122	81.00	0.0	1.00	25.00	4.00	5.00	7.00	9.00	3.32	0.0	2.51	0.0	0.0	0.0	729.00	125.00
123	49.00	0.0	1.00	121.00	17.00	11.00	9.00	7.00	3.06	1.00	2.69	1.00	0.0	0.0	343.00	1331.00
124	16.00	0.0	1.00	121.00	11.00	11.00	6.00	4.00	3.63	1.00	3.13	1.00	0.0	0.0	64.00	1331.00
125	9.00	0.0	1.00	121.00	9.00	11.00	5.00	3.00	2.23	1.00	2.83	1.00	0.0	0.0	27.00	1331.00
126	16.00	0.0	1.00	144.00	4.00	12.00	2.00	4.00	2.92	0.0	2.72	1.00	0.0	0.0	64.00	1728.00
127	64.00	1.00	1.00	196.00	16.00	14.00	10.00	8.00	5.99	1.00	3.16	1.00	0.0	0.0	512.00	2744.00
128	49.00	0.0	1.00	169.00	14.00	13.00	9.00	7.00	20.70	1.00	2.86	0.0	1.00	0.0	343.00	2197.00
129	25.00	0.0	1.00	81.00	15.00	9.00	7.00	5.00	2.14	1.00	2.80	1.00	0.0	0.0	125.00	729.00
130	25.00	1.00	1.00	49.00	7.00	7.00	7.00	5.00	12.68	1.00	3.19	1.00	0.0	0.0	125.00	343.00
131	4.00	0.0	1.00	49.00	10.00	7.00	4.00	2.00	6.62	1.00	3.53	1.00	0.0	0.0	8.00	343.00
132	9.00	0.0	1.00	121.00	9.00	11.00	5.00	3.00	106.70	1.00	3.29	1.00	0.0	0.0	27.00	1331.00
133	49.00	1.00	1.00	25.00	5.00	5.00	9.00	7.00	3.74	1.00	3.35	1.00	0.0	0.0	343.00	125.00
134	25.00	0.0	1.00	49.00	7.00	7.00	7.00	5.00	5.16	1.00	3.16	1.00	0.0	0.0	125.00	343.00
135	4.00	0.0	1.00	121.00	9.00	11.00	4.00	2.00	36.23	1.00	3.35	1.00	0.0	0.0	8.00	1331.00
136	4.00	0.0	1.00	121.00	9.00	11.00	4.00	2.00	4.01	1.00	2.89	1.00	0.0	0.0	8.00	1331.00
137	25.00	1.00	1.00	49.00	7.00	7.00	7.00	5.00	5.70	1.00	3.13	1.00	0.0	0.0	125.00	343.00
138	25.00	0.0	1.00	81.00	15.00	9.00	7.00	5.00	4.31	1.00	3.32	1.00	0.0	0.0	125.00	729.00
139	49.00	1.00	1.00	169.00	14.00	13.00	9.00	7.00	12.18	1.00	2.94	0.0	1.00	0.0	343.00	2197.00
140	64.00	0.0	1.00	196.00	16.00	14.00	10.00	8.00	16.95	1.00	3.22	0.0	1.00	0.0	512.00	2744.00
141	49.00	0.0	1.00	121.00	17.00	11.00	9.00	7.00	4.01	1.00	3.00	1.00	0.0	0.0	343.00	1331.00
142	49.00	1.00	1.00	169.00	14.00	13.00	9.00	7.00	5.75	1.00	3.25	0.0	1.00	0.0	343.00	2197.00
143	25.00	0.0	1.00	81.00	15.00	9.00	7.00	5.00	5.10	1.00	3.19	1.00	0.0	0.0	125.00	729.00
144	49.00	1.00	1.00	121.00	17.00	11.00	9.00	7.00	5.10	1.00	3.19	1.00	0.0	0.0	343.00	1331.00
145	9.00	0.0	1.00	121.00	9.00	11.00	5.00	3.00	7.32	1.00	2.92	1.00	0.0	0.0	27.00	1331.00

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146   16.00   0.0    1.00   64.00  12.00   8.00    6.00    4.00    6.42   1.00   2.92   0.0    1.00   0.0    64.00  512.00
147   25.00   0.0    1.00  121.00  13.00  11.00    7.00    5.00    4.53   1.00   3.10   0.0    0.0    1.00  125.00 1331.00
148   16.00   1.00   1.00   81.00   9.00   9.00    6.00    4.00    5.31   1.00   3.03   0.0    1.00   0.0    64.00  729.00
149   16.00   0.0    1.00   49.00  14.00   7.00    6.00    4.00    5.31   1.00   2.97   0.0    1.00   0.0    64.00  343.00
150   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00    5.42   1.00   3.35   0.0    1.00   0.0    64.00  729.00
151   25.00   0.0    1.00  121.00  13.00  11.00    7.00    5.00    8.08   1.00   2.97   0.0    1.00   0.0   125.00 1331.00
152   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   20.29   1.00   3.25   0.0    1.00   0.0    64.00  729.00
153   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   23.57   1.00   3.06   0.0    1.00   0.0    64.00  729.00
154   16.00   0.0    1.00   49.00  14.00   7.00    6.00    4.00   26.84   1.00   3.16   0.0    0.0    1.00   64.00  343.00
155   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   12.18   1.00   3.16   0.0    0.0    1.00   64.00  729.00
156   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   18.36   1.00   3.10   0.0    0.0    1.00   64.00  729.00
157   25.00   0.0    1.00  121.00  13.00  11.00    7.00    5.00    9.03   1.00   3.03   0.0    0.0    1.00  125.00 1331.00
158   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00    9.21   1.00   3.00   0.0    0.0    1.00   64.00  729.00
159   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   14.30   1.00   3.29   0.0    0.0    1.00   64.00  729.00
160   25.00   1.00   1.00  100.00  10.00  10.00    7.00    5.00   13.74   1.00   3.39   0.0    0.0    1.00  125.00 1000.00
161    4.00   0.0    1.00   49.00  10.00   7.00    4.00    2.00    7.03   1.00   3.10   0.0    0.0    1.00    8.00  343.00
162   16.00   0.0    1.00   81.00   9.00   9.00    6.00    4.00   12.81   1.00   3.56   0.0    0.0    1.00   64.00  729.00
163   16.00   1.00   1.00   81.00   9.00   9.00    6.00    4.00    9.58   1.00   3.19   0.0    0.0    1.00   64.00  729.00

           33     34     35     36     37     38      39      40      41     42     43     44     45     46     47     48
  1 9572.00   0.08   0.0    1.62   1.00   0.0   280.00  220.00   1.00  28.00  35.00  43.00  60.00  12.00   0.74   2.46
  2 9625.00   0.61   1.00   1.54   0.0    0.0    90.00  300.00   0.0   34.00  41.00  46.00  63.00  19.00   0.41   1.49
  3 9213.00   0.33   0.0    1.59   0.0    0.0   101.00   90.00   0.0   32.00  39.00  44.00  58.00  16.00   0.45   1.82
  4 9430.00   0.50   1.00   1.60   0.0    0.0    98.00  290.00   0.0   32.00  39.00  41.00  55.00  16.00   0.45   1.82
  5 9213.00   0.33   0.0    1.59   0.0    0.0   145.00   90.00   0.0   32.00  39.00  44.00  58.00  16.00   0.45   1.82
  611500.00   0.41   0.0    1.78   1.00   0.0   131.00  150.00   0.0   34.00  41.00  46.00  60.00  18.00   0.45   1.82
  710030.00   0.37   0.0    1.65   0.0    0.0   134.00  310.00   0.0   39.00  46.00  51.00  68.00  23.00   0.45   1.82
  813750.00   0.50   0.0    1.99   1.00   0.0   107.00  200.00   1.00  35.00  42.00  47.00  61.00  19.00   0.45   4.06
  910030.00   0.37   0.0    1.65   0.0    0.0   113.00  120.00   0.0   42.00  49.00  51.00  68.00  26.00   0.45   1.82
 1010000.00   0.33   0.0    1.65   1.00   0.0   228.00  300.00   1.00  34.00  41.00  46.00  60.00  18.00   0.45   4.06
 1110500.00   0.12   0.0    1.69   0.0    0.0   250.00   10.00   1.00  28.00  35.00  43.00  60.00  12.00   0.74   2.46
 1212000.00   0.61   0.0    1.82   0.0    0.0   124.00  300.00   0.0   32.00  39.00  44.00  61.00  16.00   0.41   1.49
 13 8378.00   1.00   0.0    1.52   0.0    0.0    77.00  142.00   1.00  34.00  41.00  46.00  60.00  18.00   0.55   4.06
 1414392.00   0.30   0.0    2.05   1.00   0.0   101.00  140.00   0.0   34.00  41.00  43.00  60.00  18.00   0.55   2.72
 1510575.00   0.30   1.00   1.70   0.0    1.00   85.00  130.00   0.0   31.00  38.00  43.00  60.00  15.00   0.55   2.46
 1510600.00   0.22   0.0    1.70   0.0    1.00  173.00   70.00   1.00  30.00  37.00  45.00  62.00  14.00   0.55   2.46
 17 9440.00   1.00   0.0    1.60   0.0    0.0    85.00  112.00   1.00  32.00  39.00  44.00  58.00  16.00   0.55   4.06
 18 7300.00   1.00   0.0    1.48   0.0    0.0    18.00  392.00   1.00  32.00  39.00  52.00  66.00  16.00   0.45   1.82
 19 9991.00   0.37   0.0    1.65   1.00   0.0   114.00  300.00   1.00  34.00  41.00  46.00  63.00  18.00   0.50   1.65
 2013560.00   0.18   0.0    1.97   0.0    0.0    35.00   40.00   1.00  28.00  35.00  37.00  55.00  12.00   0.55   1.35
 21 9000.00   0.22   0.0    1.57   0.0    1.00  414.00  120.00   1.00  32.00  39.00  41.00  58.00  16.00   0.61   3.00
 2211600.00   0.18   0.0    1.79   1.00   0.0   117.00   65.00   1.00  30.00  37.00  45.00  62.00  14.00   0.55   2.46
 23 9945.00   0.37   0.0    1.64   0.0    0.0   114.00  320.00   0.0   33.00  40.00  45.00  62.00  17.00   0.50   2.01
 24 9120.00   0.27   0.0    1.58   1.00   0.0   116.00   40.00   0.0   30.00  37.00  45.00  62.00  14.00   0.50   2.01
 2513125.00   1.00   0.0    1.93   0.0    0.0    18.00  424.00   0.0   32.00  39.00  52.00  66.00  16.00   0.45   1.82
 26 9512.00   0.55   0.0    1.61   0.0    0.0   107.00  300.00   0.0   33.00  40.00  42.00  56.00  17.00   0.45   1.82
 27 7725.00   0.55   1.00   1.47   0.0    0.0   132.00  440.00   0.0   34.00  41.00  46.00  60.00  18.00   0.45   1.82
 28 9840.00   0.61   0.0    1.64   0.0    0.0    60.00  296.00   0.0   42.00  49.00  54.00  68.00  26.00   0.41   1.49
 2915000.00   0.61   0.0    2.12   1.00   0.0    64.00  392.00   0.0   34.00  41.00  46.00  63.00  18.00   0.61   1.49
 3010000.00   1.00   0.0    1.65   0.0    1.00  245.00   10.00   1.00  29.00  36.00  43.00  62.00  13.00   0.50   1.49
 31 8378.00   1.00   0.0    1.52   0.0    0.0    75.00  142.00   1.00  38.00  45.00  50.00  64.00  18.00   0.55   4.06
 32 9440.00   1.00   0.0    1.60   0.0    0.0    83.00  136.00   1.00  34.00  41.00  46.00  60.00  18.00   0.55   4.06
 3312600.00   1.00   1.00   1.88   0.0    0.0   131.00  302.00   0.0   35.00  42.00  55.00  69.00  19.00   0.41   1.49
 34 8378.00   1.00   0.0    1.52   0.0    0.0   119.00  136.00   1.00  34.00  41.00  46.00  60.00  18.00   0.55   4.06
 35 8378.00   1.00   0.0    1.52   0.0    0.0    75.00  148.00   1.00  38.00  45.00  50.00  64.00  18.00   0.55   4.06
 36 8614.00   1.00   0.0    1.54   0.0    0.0   119.00  136.00   1.00  44.00  51.00  56.00  70.00  18.00   0.55   4.06
 37 9213.00   0.33   0.0    1.59   1.00   0.0   114.00   90.00   0.0   32.00  39.00  44.00  61.00  16.00   0.45   1.82
 3810900.00   0.41   0.0    1.65   0.0    0.0   138.00   90.00   0.0   32.00  39.00  41.00  55.00  16.00   0.45   1.82
 39 9465.00   1.00   1.00   1.61   0.0    0.0    70.00  328.00   0.0   32.00  39.00  52.00  66.00  16.00   0.41   1.65
 4011610.00   1.00   0.0    1.79   0.0    0.0    71.00  346.00   0.0   32.00  39.00  52.00  66.00  16.00   0.41   1.65
 4110626.00   1.00   0.0    1.70   0.0    0.0    70.00  326.00   0.0   32.00  39.00  52.00  66.00  16.00   0.41   1.65
 4210626.00   1.00   0.0    1.70   0.0    0.0     70.00  338.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.55
 43 9465.00   1.00   0.0    1.61   0.0    0.0     70.00  328.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.65
 44 9465.00   1.00   0.0    1.61   0.0    0.0     70.00  322.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.65
 4510626.00   1.00   0.0    1.70   0.0    0.0     48.00  300.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.65
 46 9465.00   1.00   0.0    1.61   0.0    0.0     70.00  318.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.65
 47 9465.00   1.00   0.0    1.61   0.0    0.0     70.00  328.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.55
 4811500.00   1.00   0.0    1.78   0.0    0.0     48.00  300.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.55
 4910626.00   1.00   0.0    1.70   0.0    0.0     48.00  300.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.65
 50 8378.00   1.00   0.0    1.52   0.0    0.0    119.00  128.00   1.00   44.00   51.00   56.00   70.00   18.00   0.55   4.06
 51 8614.00   1.00   1.00   1.34   0.0    0.0    119.00  146.00   1.00   44.00   51.00   56.00   70.00   18.00   0.55   4.06
 52 6500.00   1.00   1.00   1.38   0.0    0.0    167.00   76.00   0.0    33.00   40.00   45.00   59.00   17.00   0.45   2.01
 53 6400.00   1.00   1.00   1.39   0.0    0.0    157.00   83.00   0.0    35.00   42.00   47.00   61.00   17.00   0.45   2.01
 5410600.00   0.22   0.0    1.70   0.0    1.00    40.00  150.00   1.00   31.00   38.00   46.00   63.00   15.00   0.55   2.46
 5512000.00   0.30   1.00   1.82   1.00   0.0    127.00  400.00   1.00   32.00   39.00   47.00   64.00   16.00   0.50   3.00
 56 9270.00   0.55   1.00   1.59   0.0    0.0     96.00  110.00   0.0    35.00   42.00   44.00   58.00   19.00   0.45   1.92
 5710875.00   1.00   0.0    1.72   0.0    0.0    117.00  368.00   0.0    34.00   41.00   54.00   60.00   18.00   0.45   1.82
 5810000.00   0.55   0.0    1.65   1.00   0.0     90.00  400.00   1.00   35.00   42.00   47.00   61.00   19.00   0.50   3.00
 5915750.00   1.00   0.0    2.20   0.0    0.0    117.00  334.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 6012500.00   1.00   0.0    1.87   0.0    0.0    117.00  309.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 61 9512.00   0.45   0.0    1.61   0.0    0.0    109.00  360.00   0.0    31.00   39.00   40.00   54.00   15.00   0.45   1.82
 62 6500.00   1.00   1.00   1.38   0.0    0.0     88.00  108.00   0.0    34.00   41.00   46.00   60.00   16.00   0.45   2.01
 63 7380.00   1.00   1.00   1.45   0.0    0.0     73.00  136.00   0.0    32.00   39.00   44.00   58.00   14.00   0.45   2.01
 6410435.00   1.00   0.0    1.58   0.0    0.0    110.00  312.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 6510626.00   1.00   0.0    1.70   0.0    0.0    117.00  308.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 6610626.00   1.00   0.0    1.70   0.0    0.0    117.00  318.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.45
 6710626.00   1.00   0.0    1.70   0.0    0.0    117.00  318.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.55
 6811500.00   1.00   0.0    1.78   0.0    0.0     85.00  250.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.55
 6910626.00   1.00   0.0    1.70   0.0    0.0    133.00  260.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 70 9465.00   1.00   1.00   1.61   0.0    0.0    117.00  312.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 71 9465.00   1.00   0.0    1.61   0.0    0.0    117.00  298.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 7210626.00   1.00   0.0    1.70   0.0    0.0     86.00  240.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.55
 7310626.00   1.00   0.0    1.70   0.0    0.0     86.00  260.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 7410626.00   1.00   0.0    1.70   0.0    0.0     86.00  260.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.65
 75 9270.00   0.55   1.00   1.59   0.0    0.0    110.00  180.00   0.0    35.00   42.00   44.00   58.00   19.00   0.45   1.82
 7610000.00   0.61   1.00   1.65   0.0    0.0     69.00  463.00   0.0    35.00   42.00   47.00   61.00   19.00   0.41   1.49
 7710168.00   0.50   0.0    1.65   1.00   0.0    129.00  515.00   0.0    31.00   38.00   40.00   54.00   15.00   0.35   1.82
 78 8614.00   1.00   0.0    1.54   0.0    0.0    117.00   59.00   1.00   32.00   39.00   44.00   59.00   16.00   0.55   4.06
 79 8378.00   1.00   0.0    1.52   0.0    0.0    113.00  118.00   1.00   31.00   38.00   43.00   57.00   15.00   0.55   4.06
 80 8378.00   1.00   0.0    1.52   0.0    0.0    117.00  126.00   1.00   32.00   39.00   44.00   59.00   16.00   0.55   4.06
 8110000.00   0.37   0.0    1.65   1.00   0.0    235.00  300.00   1.00   32.00   39.00   44.00   59.00   16.00   0.45   4.06
 82 9880.00   0.55   1.00   1.64   1.00   0.0    125.00  330.00   0.0    41.00   48.00   53.00   67.00   25.00   0.45   1.92
 8310710.00   0.27   0.0    1.71   1.00   0.0    140.00  130.00   1.00   35.00   42.00   50.00   64.00   19.00   0.51   2.46
 8412240.00   0.14   0.0    1.84   1.00   0.0     83.00  265.00   0.0    28.00   35.00   43.00   60.00   12.00   0.55   2.46
 8511700.00   1.00   1.00   1.79   0.0    0.0    149.00  304.00   0.0    35.00   42.00   55.00   69.00   19.00   0.41   1.49
 8613500.00   1.00   1.00   1.96   0.0    0.0     89.00  229.00   0.0    32.00   39.00   52.00   66.00   16.00   0.41   1.49
 8715000.00   1.00   1.00   2.12   1.00   0.0     92.00  249.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.49
 8814500.00   0.41   1.00   2.06   1.00   0.0    100.00  500.00   1.00   32.00   40.00   45.00   59.00   16.00   0.50   3.00
 8910465.00   0.55   0.0    1.69   0.0    0.0    110.00  370.00   0.0    33.00   40.00   45.00   59.00   17.00   0.41   1.55
 9010435.00   1.00   0.0    1.68   0.0    0.0     94.00  318.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 9110626.00   1.00   0.0    1.70   0.0    0.0     94.00  318.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 9212650.00   1.00   0.0    1.88   0.0    0.0     95.00  334.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 93 9465.00   1.00   0.0    1.61   0.0    0.0     95.00  308.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 9410626.00   1.00   0.0    1.70   0.0    0.0     76.00  260.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 9510626.00   1.00   0.0    1.70   0.0    0.0     76.00  260.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.65
 96 9465.00   1.00   1.00   1.61   0.0    0.0     95.00  298.00   0.0    31.00   38.00   51.00   65.00   15.00   0.41   1.55
 9710000.00   0.55   0.0    1.65   0.0    0.0    116.00  220.00   0.0    30.00   37.00   42.00   56.00   14.00   0.41   1.65
 98 9720.00   0.55   0.0    1.63   0.0    0.0    218.00  320.00   0.0    35.00   42.00   47.00   64.00   19.00   0.41   1.49
 99 9125.00   1.00   0.0    1.58   0.0    0.0    128.00  262.00   0.0    34.00   41.00   54.00   68.00   18.00   0.41   1.49
10011000.00   0.18   0.0    1.73   1.00   0.0    107.00  108.00   1.00   32.00   39.00   41.00   58.00   16.00   0.74   3.00
10112500.00   0.27   1.00   1.87   1.00   0.0    211.00  400.00   1.00   31.00   38.00   46.00   63.00   15.00   0.50   3.00
10210000.00   0.61   0.0    1.65   0.0    1.00   108.00  480.00   1.00   34.00   41.00   46.00   60.00   18.00   0.45   4.06
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10314700.00	0.27	0.0	2.09	1.00	0.0	230.00	260.00	1.00	31.00	38.00	46.00	65.00	15.00	0.67	3.00
104 9785.00	0.55	1.00	1.63	0.0	0.0	109.00	320.00	0.0	38.00	45.00	50.00	64.00	18.00	0.45	1.82
10510700.00	0.74	1.00	1.71	1.00	0.0	162.00	320.00	1.00	51.00	58.00	63.00	77.00	25.00	0.50	1.65
106 8950.00	0.82	1.00	1.56	0.0	0.0	158.00	416.00	0.0	32.00	39.00	44.00	58.00	16.00	0.45	1.82
10710000.00	0.55	0.0	1.65	1.00	0.0	93.00	330.00	1.00	42.00	49.00	57.00	71.00	16.00	0.50	1.49
10813650.00	0.61	1.00	1.98	1.00	0.0	214.00	330.00	1.00	39.00	46.00	51.00	65.00	23.00	0.50	3.67
10912500.00	0.25	1.00	1.87	1.00	0.0	140.00	720.00	1.00	39.00	46.00	54.00	68.00	23.00	0.50	3.00
11012500.00	0.33	0.0	1.87	0.0	1.00	360.00	300.00	1.00	31.00	33.00	43.00	60.00	15.00	0.45	4.06
111 8850.00	0.82	1.00	1.56	0.0	0.0	301.00	514.00	0.0	37.00	44.00	54.00	68.00	22.00	0.45	1.82
11216375.00	0.10	0.0	2.33	1.00	0.0	126.00	260.00	1.00	38.00	45.00	47.00	64.00	22.00	0.32	3.00
11312600.00	0.27	0.0	1.68	0.0	1.00	376.00	10.00	1.00	31.00	38.00	43.00	60.00	15.00	0.55	2.46
11412700.00	0.61	1.00	1.89	1.00	0.0	241.00	560.00	1.00	32.00	39.00	47.00	64.00	16.00	0.50	3.67
115 7700.00	0.08	0.0	1.47	0.0	1.00	301.00	200.00	1.00	37.00	44.00	52.00	69.00	11.00	0.74	2.46
11611500.00	0.55	0.0	1.78	1.00	0.0	162.00	370.00	0.0	39.00	46.00	48.00	62.00	23.00	0.41	1.65
11715252.00	0.20	0.0	2.14	1.00	0.0	92.00	610.00	1.00	39.00	46.00	54.00	71.00	23.00	0.92	3.00
11820000.00	1.00	0.0	2.72	0.0	1.00	126.00	256.00	0.0	42.00	49.00	62.00	76.00	26.00	0.55	2.72
11915000.00	0.61	0.0	2.12	1.00	0.0	131.00	580.00	1.00	37.00	44.00	49.00	63.00	21.00	0.50	3.57
12012500.00	0.82	1.00	1.87	1.00	0.0	64.00	507.00	1.00	40.00	47.00	52.00	66.00	24.00	0.45	4.06
12110800.00	1.00	0.0	1.72	1.00	0.0	178.00	342.00	1.00	42.00	49.00	62.00	76.00	26.00	0.50	1.65
12211500.00	0.55	0.0	1.78	1.00	0.0	120.00	390.00	0.0	30.00	37.00	39.00	53.00	14.00	0.41	1.65
12315000.00	0.41	1.00	2.12	1.00	0.0	112.00	490.00	1.00	34.00	41.00	46.00	60.00	18.00	0.50	3.00
12412500.00	0.37	0.0	1.87	0.0	1.00	129.00	250.00	1.00	39.00	46.00	54.00	71.00	23.00	0.57	3.00
12511000.00	0.14	0.0	1.73	0.0	0.0	80.00	25.00	1.00	30.00	37.00	45.00	62.00	12.00	0.74	3.00
126 7650.00	0.67	1.00	1.47	0.0	1.00	107.00	140.00	1.00	32.00	39.00	47.00	61.00	16.00	0.67	3.32
12716500.00	1.00	1.00	2.28	1.00	0.0	179.00	192.00	1.00	40.00	47.00	57.00	71.00	24.00	0.45	4.06
12810500.00	0.45	0.0	1.69	1.00	0.0	303.00	550.00	1.00	30.00	37.00	45.00	62.00	14.00	0.50	3.67
12914190.00	0.61	0.0	2.03	1.00	0.0	76.00	710.00	1.00	38.00	45.00	50.00	64.00	22.00	0.61	2.46
13011900.00	1.00	0.0	1.81	1.00	0.0	254.00	232.00	1.00	41.00	48.00	58.00	72.00	25.00	0.61	2.01
13110150.00	0.06	1.00	1.68	0.0	1.00	189.00	200.00	1.00	48.00	55.00	63.00	80.00	22.00	0.32	2.01
13216800.00	0.37	1.00	2.32	0.0	1.00	467.00	650.00	1.00	39.00	47.00	55.00	72.00	23.00	0.74	3.00
13310700.00	1.00	1.00	1.71	0.0	1.00	132.00	430.00	1.00	42.00	50.00	63.00	77.00	26.00	0.50	1.65
13410000.00	0.82	0.0	1.65	1.00	0.0	164.00	410.00	1.00	39.00	47.00	57.00	71.00	23.00	0.61	2.01
13517050.00	0.12	0.0	2.35	1.00	0.0	359.00	500.00	1.00	38.00	46.00	57.00	74.00	22.00	0.82	3.00
13617050.00	0.10	0.0	2.35	1.00	0.0	139.00	700.00	1.00	28.00	35.00	43.00	60.00	12.00	0.82	3.00
13710000.00	1.00	0.0	1.65	0.0	0.0	174.00	448.00	1.00	37.00	44.00	54.00	68.00	21.00	0.51	2.01
13310000.00	0.61	1.00	1.65	1.00	0.0	146.00	470.00	1.00	43.00	50.00	58.00	75.00	15.00	0.51	2.46
13916610.00	1.00	0.0	2.29	0.0	1.00	250.00	440.00	1.00	38.00	45.00	50.00	64.00	22.00	0.50	3.57
14012715.00	0.90	1.00	1.91	0.0	1.00	283.00	375.00	1.00	39.00	46.00	59.00	73.00	23.00	0.45	4.06
14112650.00	0.90	1.00	1.88	1.00	0.0	139.00	396.00	1.00	37.00	44.00	54.00	59.00	21.00	0.50	3.00
14219315.00	1.00	0.0	2.50	0.0	1.00	175.00	395.00	1.00	48.00	55.00	60.00	74.00	22.00	0.50	3.67
143 9700.00	0.61	1.00	1.62	1.00	0.0	163.00	310.00	1.00	42.00	49.00	57.00	74.00	14.00	0.51	2.46
14413200.00	1.00	1.00	1.93	1.00	0.0	163.00	544.00	1.00	37.00	45.00	58.00	72.00	21.00	0.50	3.00
14515012.00	0.12	0.0	2.12	1.00	0.0	199.00	275.00	1.00	30.00	37.00	45.00	62.00	14.00	0.74	3.00
14613200.00	0.30	1.00	1.93	0.0	1.00	186.00	1130.00	1.00	37.00	45.00	50.00	67.00	21.00	0.67	2.23
14715400.00	0.74	1.00	2.16	0.0	1.00	151.00	1360.00	1.00	38.00	45.00	53.00	67.00	22.00	0.61	3.00
14813000.00	1.00	1.00	1.92	1.00	0.0	167.00	295.00	1.00	37.00	45.00	53.00	67.00	21.00	0.67	2.46
14914000.00	0.41	0.0	2.01	0.0	1.00	167.00	900.00	1.00	37.00	44.00	52.00	66.00	21.00	0.67	2.01
15015950.00	0.61	1.00	2.22	0.0	1.00	169.00	520.00	1.00	43.00	51.00	59.00	76.00	23.00	0.57	2.46
15116241.00	0.55	1.00	2.25	1.00	0.0	209.00	818.00	1.00	37.00	45.00	55.00	69.00	21.00	0.51	3.00
15212410.00	0.82	1.00	1.88	0.0	1.00	301.00	890.00	1.00	38.00	45.00	58.00	72.00	22.00	0.67	2.46
15313260.00	0.82	1.00	1.94	0.0	1.00	316.00	855.00	1.00	37.00	44.00	54.00	68.00	22.00	0.67	2.46
15414000.00	0.90	0.0	2.01	0.0	1.00	329.00	391.00	1.00	37.00	45.00	55.00	59.00	21.00	0.57	2.01
15514850.00	0.90	1.00	2.10	0.0	1.00	250.00	807.00	1.00	37.00	45.00	55.00	69.00	21.00	0.67	2.46
15614850.00	0.90	1.00	2.10	0.0	1.00	291.00	803.00	1.00	38.00	46.00	56.00	70.00	22.00	0.67	2.46
15715805.00	0.90	1.00	2.20	1.00	0.0	220.00	900.00	1.00	37.00	45.00	55.00	69.00	21.00	0.51	3.00
15813260.00	0.90	1.00	1.94	0.0	1.00	222.00	945.00	1.00	37.00	45.00	52.00	66.00	21.00	0.67	2.46
15714300.00	0.82	1.00	2.04	0.0	1.00	266.00	840.00	1.00	41.00	48.00	61.00	75.00	21.00	0.67	2.46
16013200.00	1.00	1.00	1.93	0.0	1.00	262.00	366.00	1.00	42.00	49.00	62.00	76.00	22.00	0.61	2.72
16110000.00	0.22	1.00	1.65	0.0	1.00	195.00	1130.00	1.00	37.00	45.00	53.00	70.00	21.00	0.82	2.01
16213260.00	0.82	1.00	1.94	0.0	1.00	255.00	860.00	1.00	49.00	57.00	70.00	87.00	21.00	0.57	2.46
16317400.00	1.00	1.00	2.39	0.0	1.00	226.00	860.00	1.00	38.00	46.00	56.00	70.00	22.00	0.67	2.46

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                49         50
     1       14.00       1.00
     2      123.00       1.00
     3      125.00       1.00
     4      137.00       1.00
     5       19.00       1.00
     6      138.00       1.00
     7      125.00       1.00
     8        9.00       1.00
     9       30.00       1.00
    10       20.00       1.00
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    60       55.00       1.00
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 68    68.00    1.00
 69    64.00    1.00
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 92    20.00    1.00
 93    97.00    1.00
 94   109.00    1.00
 95   116.00    1.00
 96   104.00    1.00
 97   104.00    1.00
 98    64.00    1.00
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100   115.00    1.00
101   104.00    1.00
102   123.00    1.00
103    90.00    1.00
104    88.00    1.00
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107    12.00    1.00
108   118.00    1.00
109     8.00    1.00
110   135.00    1.00
111     9.00    1.00
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114   122.00    1.00
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116    48.00    1.00
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118    68.00    1.00
119    15.00    1.00
120    70.00    1.00
121    71.00    1.00
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128   153.00    1.00
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131    83.00    1.00
132    13.00    1.00
133   139.00    1.00
134    35.00    1.00
135   161.00    1.00
136     1.00    1.00
137     8.00    1.00
138     2.00    1.00
139    33.00    1.00
140   122.00    1.00
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142    30.00    1.00
143    15.00    1.00
144   108.00    1.00
145   119.00    1.00
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147     6.00    1.00
148    90.00    1.00
149   180.00    1.00
150   125.00    1.00
151   151.00    1.00
152     2.00    1.00
153   130.00    1.00
154    35.00    1.00
155   119.00    1.00
156   115.00    1.00
157   128.00    1.00
158    13.00    1.00
159    32.00    1.00
160    83.00    1.00
161    71.00    1.00
162   151.00    1.00
163    75.00    1.00
  SA_EPR  EXTWA_  CA3MIL  FLOFIN  INTFIN  DTCBSQ  HTGAIR  PLUMBG  DTMSSO  QUNIMP  QU_INX  EXOBLA  SHAPEF  SIZEFA  QUNBLA  AGEIMP

  DTUFSQ  NEW 01  F235 0  DTMPSO  DISTMS  DISTMP  DISTCB  DISTJF  EXOAUX  AREA W  EXOLIX  NEIOL2  NEIOL3  NEIOL4  DTUFCU  DTMPCU

  LOTSIZ  EXPAGE  SITE 2  EXPLOT  TOPO 2  TOPO 3  QUNAUX  EXTRAF  SOIL 0  872     8723    87234   872345  87      EXDTUF  EXDTMP

  DATE
```

```
CORRELATION MATRIX

        SA_EPREXTWALCABMILFLOFININTFINDTCBSQHTGAIRPLUMBGDTMSSQOUNIMPOULINXEXOB_ASHAPEFSIZEFAOUNBLAAGEIMPDTUFSQNEW 01F235 0DTMPSQ
EXTWAL    0.19
CABMIL    0.64 -0.00
F_OFIN    0.19 -0.07  0.12
INTFIN   -0.00  0.09  0.03 -0.26
DTCBSQ    0.05 -0.12 -0.02  0.14 -0.25
HTGAIR    0.63  0.04  0.49  0.09 -0.18  0.22
PLUMBG   -0.56 -0.09 -0.34 -0.10 -0.15  0.03 -0.30
DTMSSO    0.38  0.07  0.20 -0.09  0.07  0.62  0.32 -0.29
OUNIMP    0.90  0.21  0.57  0.02  0.19 -0.01  0.56 -0.69  0.42
OU_INX    0.59  0.43  0.40  0.53  0.01  0.03  0.64 -0.15  0.19  0.45
EXOB_A    0.88  0.20  0.57  0.07  0.11 -0.05  0.50 -0.62  0.32  0.94  0.41
SHAPEF    0.33  0.14  0.31  0.00  0.35 -0.15  0.06 -0.48  0.24  0.45  0.16  0.42
SIZEFA   -0.86 -0.20 -0.51  0.01 -0.14  0.01 -0.53  0.72 -0.42 -0.97 -0.38 -0.90 -0.46
OUNBLA    0.90  0.22  0.56  0.03  0.15 -0.02  0.55 -0.71  0.40  0.98  0.42  0.96  0.47 -0.98
AGEIMP   -0.04  0.02 -0.03 -0.42  0.70 -0.23 -0.15 -0.16  0.20  0.15 -0.17  0.06  0.40 -0.13  0.11
DTUFSQ   -0.56 -0.25 -0.41  0.24 -0.44  0.39 -0.34  0.37 -0.32 -0.64 -0.38 -0.55 -0.43  0.60 -0.61 -0.50
NEW 01   -0.21 -0.01 -0.14  0.56 -0.51 -0.01 -0.13  0.20 -0.34 -0.37  0.19 -0.26 -0.31  0.38 -0.33 -0.68  0.42
F235 0    0.40  0.03  0.25 -0.49  0.43  0.14  0.37 -0.23  0.44  0.51  0.02  0.39  0.30 -0.50  0.46  0.58 -0.52 -0.85
DTMPSQ    0.16  0.15  0.05 -0.32  0.05  0.12  0.13 -0.09  0.58  0.25  0.10  0.15  0.10 -0.25  0.22  0.12 -0.47 -0.10  0.16
DISTMS    0.48  0.11  0.27 -0.07  0.10  0.53  0.38 -0.37  0.98  0.51  0.27  0.41  0.29 -0.50  0.48  0.23 -0.45 -0.33  0.44  0.62
DISTMP    0.23  0.16  0.10 -0.32  0.09  0.08  0.17 -0.14  0.61  0.32  0.13  0.21  0.15 -0.31  0.29  0.18 -0.55 -0.16  0.23  0.99
DISTCB    0.06 -0.13 -0.01  0.19 -0.28  0.99  0.22  0.01  0.56 -0.02  0.03 -0.05 -0.17  0.01 -0.03 -0.28  0.44  0.01  0.10 -0.01
DISTUF   -0.57 -0.23 -0.42  0.19 -0.46  0.41 -0.34  0.39 -0.29 -0.64 -0.40 -0.55 -0.45  0.59 -0.61 -0.54  0.99  0.41 -0.49 -0.41
EXOAUX    0.26 -0.02  0.30 -0.03  0.26 -0.07  0.18 -0.13  0.15  0.35  0.22  0.18  0.18 -0.21  0.21  0.21 -0.33 -0.24  0.25  0.18
AREA #    0.63  0.17  0.41 -0.05  0.29  0.38  0.51 -0.41  0.75  0.65  0.44  0.53  0.33 -0.61  0.62  0.32 -0.66 -0.44  0.51  0.38
EXO_IX    0.60  0.44  0.40  0.51  0.02  0.03  0.64 -0.16  0.19  0.46  1.00  0.42  0.17 -0.39  0.43 -0.16 -0.39  0.17  0.04  0.10
NEIOL2    0.09  0.07  0.03 -0.12  0.29  0.20  0.13 -0.12  0.47  0.19  0.12  0.08  0.23 -0.19  0.18  0.43 -0.34 -0.37  0.45  0.32
NEIOL3    0.38  0.11  0.20  0.02  0.03  0.11  0.31 -0.31  0.26  0.36  0.23  0.26  0.24 -0.36  0.33  0.02 -0.25 -0.09  0.20  0.16
NEIO_4    0.73  0.09  0.53  0.15 -0.06 -0.08  0.40 -0.35  0.13  0.64  0.36  0.71  0.16 -0.60  0.64 -0.12 -0.35 -0.13  0.19  0.03
DTUFCJ   -0.54 -0.26 -0.39  0.29 -0.43  0.36 -0.33  0.34 -0.35 -0.62 -0.35 -0.53 -0.40  0.60 -0.60 -0.47  0.99  0.43 -0.54 -0.51
DTMPCU    0.10  0.15 -0.00 -0.32  0.00  0.15  0.10 -0.04  0.53  0.18  0.07  0.09  0.05 -0.18  0.16  0.05 -0.38 -0.04  0.09  0.99
LOTSIZ    0.53 -0.10  0.38  0.16  0.14  0.20  0.50 -0.28  0.40  0.45  0.39  0.40  0.20 -0.42  0.44  0.13 -0.35 -0.17  0.36  0.18
EXPAGE    0.04  0.02  0.02  0.54 -0.63  0.14  0.12  0.12 -0.25 -0.16  0.27 -0.07 -0.36  0.15 -0.12 -0.95  0.44  0.81 -0.69 -0.11
SITE 2    0.44  0.16  0.35  0.03 -0.10  0.16  0.34 -0.10  0.25  0.35  0.27  0.34  0.08 -0.34  0.34 -0.13 -0.14 -0.15  0.21  0.03
EXP_DT    0.53 -0.09  0.38  0.15  0.13  0.17  0.50 -0.27  0.39  0.45  0.40  0.40  0.20 -0.42  0.44  0.12 -0.36 -0.15  0.35  0.20
TOPO 2    0.07 -0.00  0.06 -0.21  0.20  0.32  0.14 -0.11  0.49  0.19 -0.02  0.11  0.14 -0.21  0.19  0.36 -0.25 -0.39  0.45  0.24
TOPO 3    0.59  0.13  0.36  0.05  0.20 -0.11  0.36 -0.22  0.19  0.53  0.39  0.47  0.28 -0.46  0.47  0.10 -0.47 -0.23  0.35  0.16
OUNAUX    0.52  0.07  0.37 -0.03  0.27  0.04  0.35 -0.28  0.33  0.62  0.35  0.42  0.17 -0.48  0.47  0.24 -0.48 -0.36  0.46  0.26
EXTRAF    0.73 -0.04  0.52  0.20 -0.09  0.20  0.60 -0.44  0.37  0.64  0.40  0.65  0.31 -0.62  0.65 -0.07 -0.29 -0.24  0.29  0.02
SOI_ 0    0.50  0.27  0.33 -0.18  0.25  0.08  0.34 -0.31  0.61  0.56  0.39  0.44  0.28 -0.52  0.52  0.28 -0.77 -0.29  0.43  0.70
872       0.46  0.63  0.27 -0.01 -0.14  0.11  0.72  0.07  0.20  0.33  0.73  0.30 -0.03 -0.29  0.32 -0.16 -0.29 -0.04  0.23  0.17
8723      0.49  0.62  0.34  0.00 -0.13  0.11  0.74  0.04  0.21  0.36  0.74  0.34 -0.01 -0.32  0.35 -0.16 -0.32 -0.05  0.24  0.17
87234     0.50  0.42  0.33  0.64 -0.27  0.17  0.63 -0.03  0.10  0.29  0.91  0.30 -0.01 -0.24  0.29 -0.39 -0.09  0.32 -0.13 -0.09
872345    0.52  0.46  0.36  0.60 -0.02  0.12  0.61 -0.07  0.12  0.35  0.94  0.34  0.08 -0.28  0.33 -0.23 -0.20  0.20 -0.02 -0.07
87        0.44  0.00  0.35  0.05 -0.26  0.24  0.99  0.16  0.20  0.25  0.59  0.23 -0.16 -0.22  0.23 -0.23 -0.18 -0.04  0.28  0.10
EXOTUF    0.57  0.22  0.42 -0.16  0.47 -0.42  0.33 -0.40  0.27  0.63  0.41  0.55  0.47 -0.58  0.60  0.56 -0.97 -0.40  0.46  0.37
EXOTMP    0.17  0.16  0.05 -0.32  0.05  0.11  0.14 -0.10  0.58  0.25  0.10  0.15  0.10 -0.25  0.23  0.12 -0.47 -0.10  0.16  1.00
DATE      0.05 -0.07  0.15  0.03  0.23 -0.08 -0.07 -0.13  0.01  0.11 -0.04  0.11  0.15 -0.13  0.12  0.13 -0.10 -0.11  0.08  0.08

        DISTMSDISTMPDISTCBDISTUFEXOAUXAREA #EXOLIXNEIOL2NEIOL3NEIOL4DTUFCJDTMPCJ_OTSIZEXPAGESITE 2EXPLDTTOPO 2TOPO 3OUNAUXEXTRAF
DISTMP    0.66
DISTCB    0.47 -0.05
DISTUF   -0.43 -0.49  0.46
EXOAUX    0.20  0.22 -0.10 -0.34
AREA #    0.81  0.43  0.34 -0.65  0.27
EXO_IX    0.27  0.13  0.03 -0.41  0.22  0.44
```

```
NEIQL2      0.47   0.36   0.14  -0.33   0.14   0.47   0.12
NEIQL3      0.30   0.19   0.11  -0.24   0.15   0.33   0.22  -0.18
NEIQL4      0.20   0.08  -0.06  -0.36   0.14   0.31   0.36  -0.17  -0.08
DTUFCU     -0.47  -0.59   0.42   0.96  -0.32  -0.65  -0.36  -0.35  -0.25  -0.34
DTMPCJ      0.56   0.96   0.02  -0.32   0.15   0.32   0.07   0.28   0.14  -0.01  -0.42
LOTSIZ      0.44   0.22   0.19  -0.37   0.23   0.53   0.39   0.25   0.26   0.30  -0.33   0.14
EXPAGE     -0.25  -0.17   0.18   0.46  -0.21  -0.32   0.25  -0.45  -0.03   0.12   0.43  -0.05  -0.12
SITE 2      0.23   0.07   0.16  -0.13   0.10   0.25   0.27   0.04   0.13   0.31  -0.15  -0.00   0.11   0.09
EXP_DT      0.43   0.24   0.16  -0.38   0.24   0.52   0.40   0.25   0.26   0.29  -0.34   0.15   1.00  -0.11   0.12
TOPO 2      0.47   0.27   0.28  -0.23  -0.04   0.48  -0.02   0.52  -0.03  -0.13  -0.27   0.20   0.31  -0.41   0.03   0.29
TOPO 3      0.26   0.22  -0.14  -0.46   0.43   0.37   0.40   0.05   0.38   0.47  -0.46   0.12   0.32  -0.10   0.23   0.33  -0.34
QUNAJX      0.40   0.31   0.01  -0.48   0.81   0.50   0.35   0.15   0.32   0.33  -0.47   0.21   0.30  -0.24   0.21   0.30   0.08   0.53
EXTRAF      0.42   0.07   0.23  -0.31   0.16   0.49   0.40  -0.02   0.32   0.57  -0.26  -0.02   0.49   0.01   0.40   0.47   0.09   0.38   0.30
SOIL 0      0.69   0.73  -0.01  -0.73   0.30   0.78   0.39   0.43   0.26   0.25  -0.80   0.66   0.31  -0.25   0.13   0.31   0.33   0.41   0.46   0.27
872         0.24   0.19   0.10  -0.27   0.09   0.36   0.74   0.11   0.20   0.26  -0.30   0.16   0.24   0.15   0.34   0.25   0.07   0.29   0.22   0.30
8723        0.25   0.19   0.10  -0.30   0.11   0.39   0.75   0.11   0.21   0.29  -0.32   0.16   0.26   0.15   0.36   0.27   0.07   0.31   0.24   0.33
87234       0.15  -0.06   0.20  -0.11   0.06   0.26   0.90   0.00   0.18   0.32  -0.06  -0.09   0.30   0.46   0.29   0.30  -0.08   0.27   0.16   0.38
872345      0.18  -0.05   0.14  -0.23   0.13   0.35   0.94   0.08   0.19   0.31  -0.18  -0.09   0.35   0.30   0.28   0.35  -0.03   0.33   0.24   0.38
87          0.22   0.11   0.23  -0.17   0.12   0.33   0.59   0.08   0.18   0.26  -0.18   0.08   0.39   0.18   0.31   0.39   0.09   0.27   0.23   0.42
EXDTUF      0.41   0.45  -0.47  -0.99   0.34   0.64   0.42   0.32   0.23   0.35  -0.93   0.28   0.38  -0.46   0.12   0.38   0.21   0.45   0.47   0.32
EXDTMP      0.62   0.99  -0.01  -0.41   0.19   0.38   0.10   0.32   0.17   0.04  -0.51   0.99   0.18  -0.12   0.03   0.20   0.24   0.17   0.27   0.03
DATE        0.01   0.08  -0.09  -0.09  -0.06   0.03  -0.04   0.09   0.17   0.02  -0.11   0.08   0.03  -0.14   0.05   0.02  -0.02   0.15  -0.02  -0.00

         SOIL 0872    8723   87234 87234587     EXDTUFEXDTMP
872         0.33
8723        0.35   1.00
87234       0.15   0.76   0.77
872345      0.22   0.75   0.76   0.97
87          0.21   0.78   0.79   0.63   0.59
EXDTUF      0.69   0.26   0.28   0.12   0.24   0.16
EXDTMP      0.70   0.17   0.17  -0.08  -0.07   0.10   0.37
DATE        0.07  -0.15  -0.14  -0.09  -0.03  -0.13   0.09   0.08
```

APPENDIX C

Abridged Computer Print-out of Scatters of Selected Regressors and the Regressand, Based on Program ECON[a]

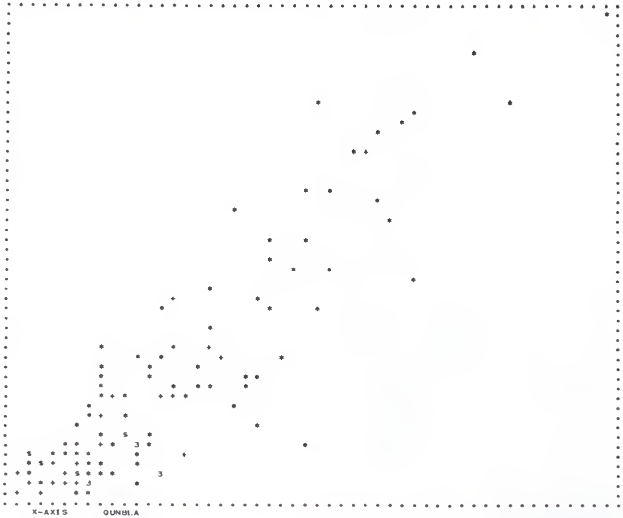
Data Code

The variables in each scatter are coded by acronyms. See Appendix A for a description of each variable.

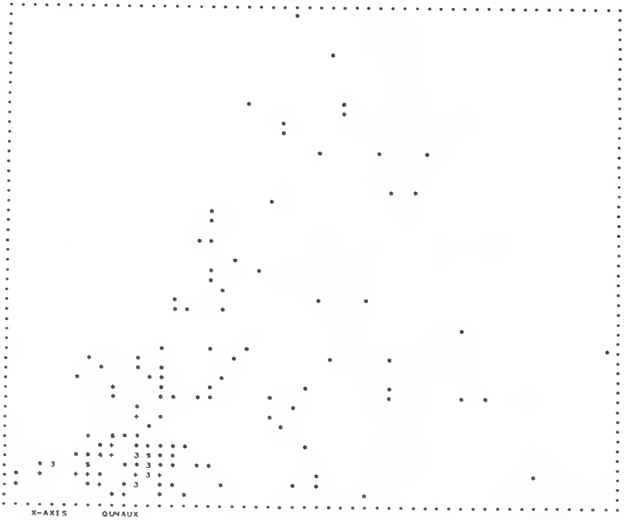
---

[a] The original ECON regression program was written by Mr. M.R. Norman of M.I.T.

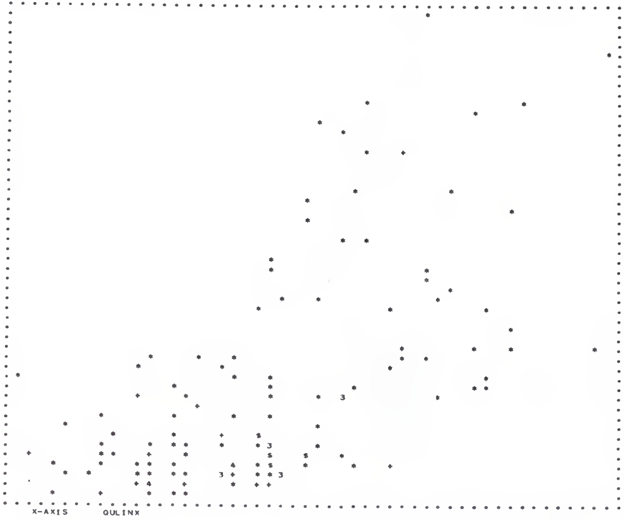
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE       15000.000       43000.000
X-AXIS  QUNBLA  RANGE         900.000        2772.000
CODE OF SYMBOL    *=1    +=2    $=OVER 4
```



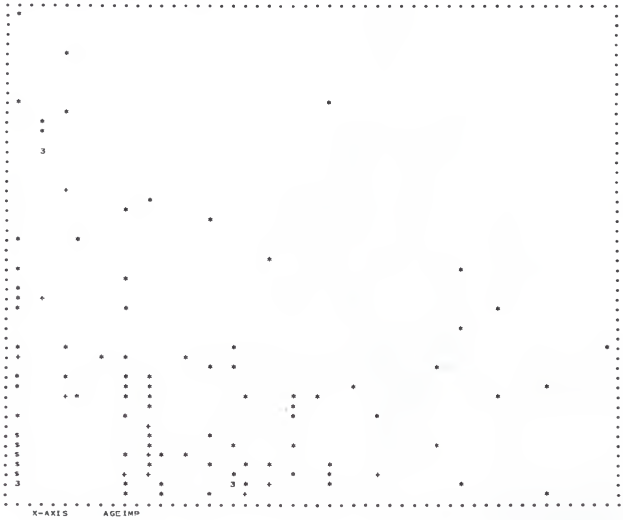
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE        15000.000       43000.000
X-AXIS  QUNAUX  RANGE           18.000         467.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



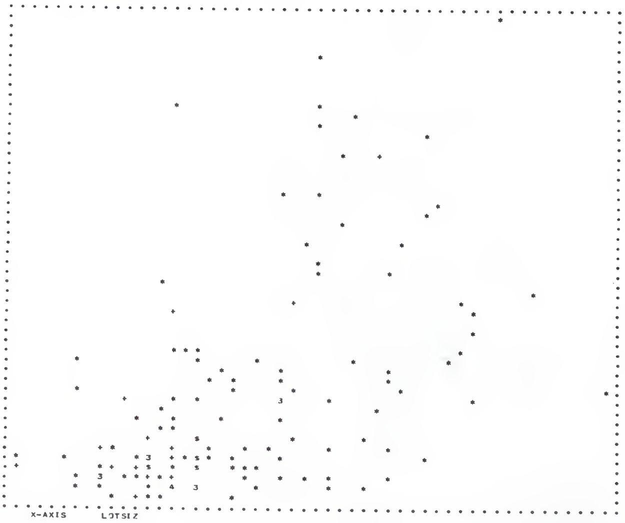
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE       15000.000       43000.000
X-AXIS  QULINX  RANGE          92.000         127.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



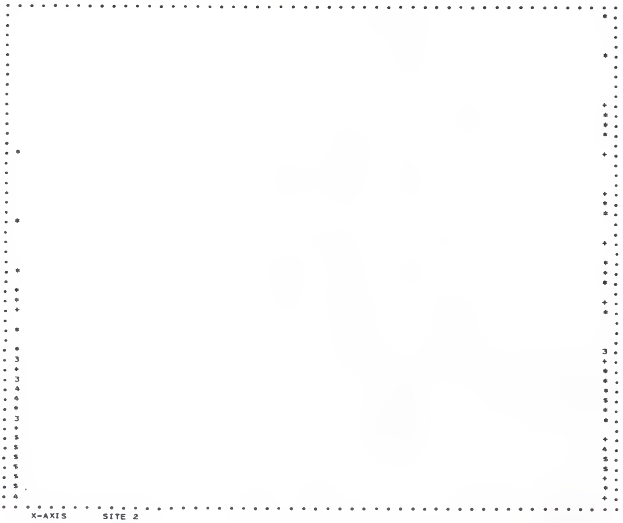
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE      15000.000      43000.000
X-AXIS  AGEIMP  RANGE          0.0           28.000
CODE OF SYMBOL   *=1    +=2   $=OVER 4
```



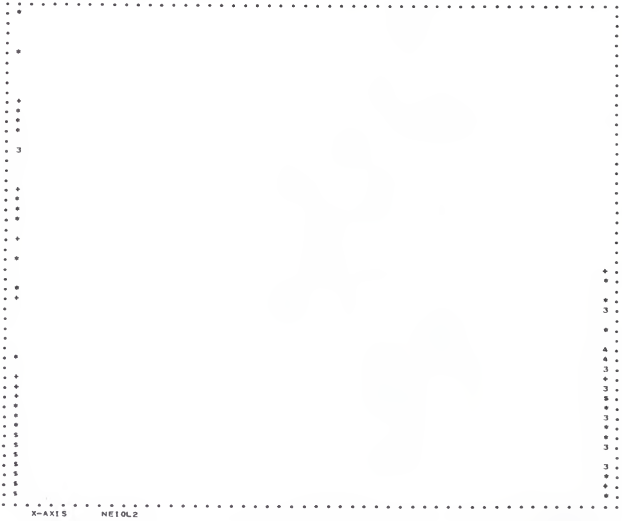
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE       15000.000       43000.000
X-AXIS  LOTSIZ  RANGE        6400.000       20000.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



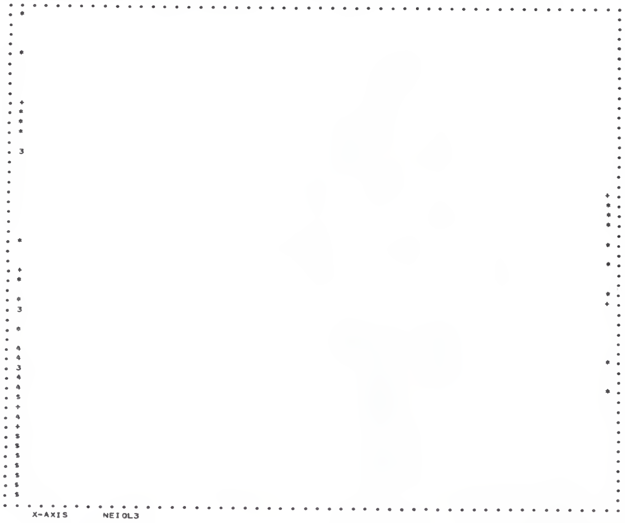
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE      15000.000       43000.000
X-AXIS  SITE 2  RANGE          0.0             1.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



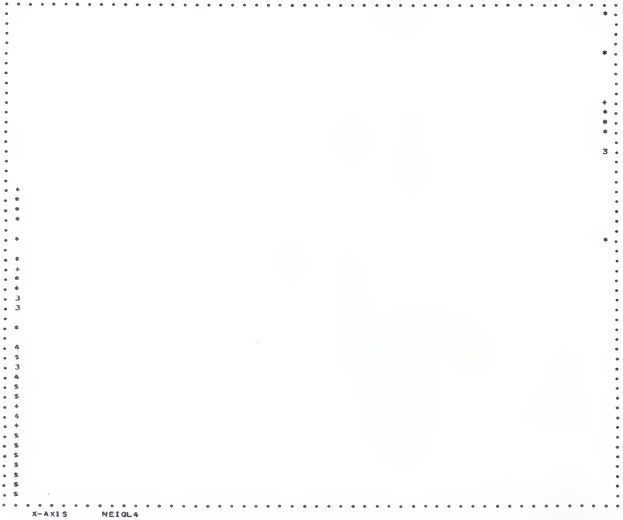
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE      15000.000      43000.000
X-AXIS  NEIOL2  RANGE          0.0            1.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



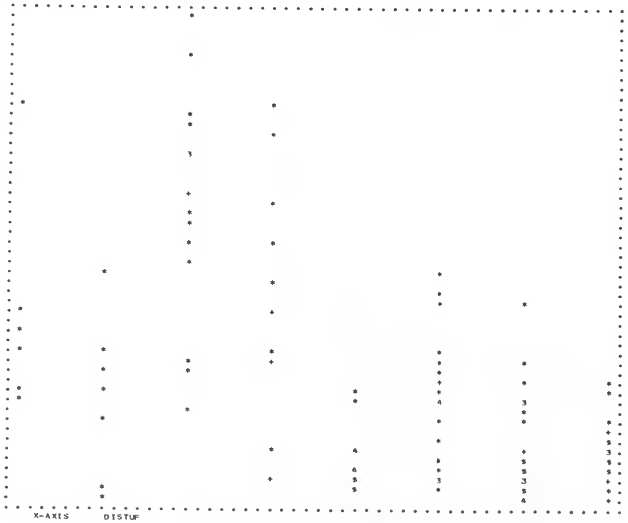
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE        15000.000        43000.000
X-AXIS  NEIOL3  RANGE              0.0            1.000
CODE OF SYMBOL    *=1    +=2    $=OVER 4
```



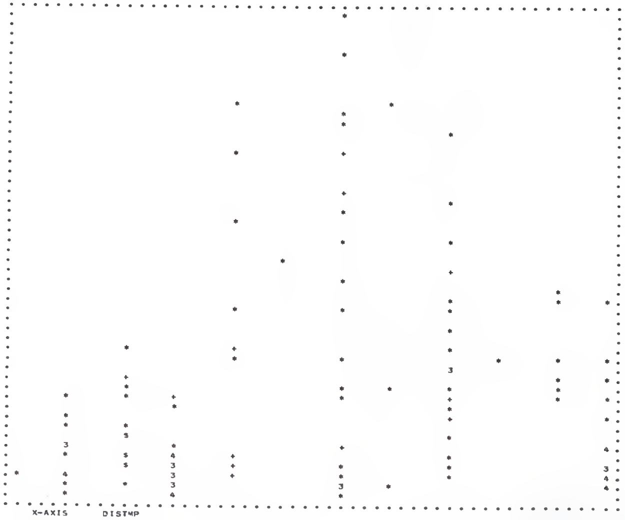
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE      15000.000       43000.000
X-AXIS  NEIQL4  RANGE          0.0             1.000
CODE OF SYMBOL   *=1    +=2    $=OVER 4
```



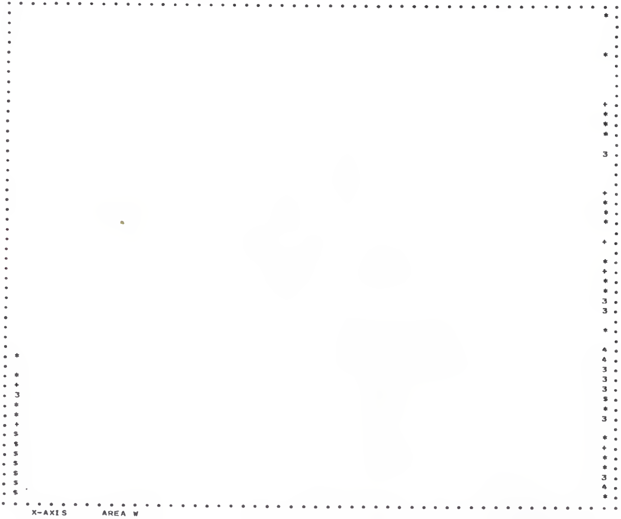
```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE      15000.000       43000.000
X-AXIS  DISTUF  RANGE          2.000           9.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALEPR  RANGE       15000.000        43000.000
X-AXIS  DISTMP  RANGE           3.000           14.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



```
SCATTER DIAGRAM WITH VARYING SCALE
Y-AXIS  SALFPR  RANGE      15000.000      43000.000
X-AXIS  AREA W  RANGE          0.0            1.000
CODE OF SYMBOL   *=1   +=2   $=OVER 4
```



APPENDIX D

Abridged Computer Print-out of Matrices and Statistics for the Selected Multiple Regression Equation, Based on Program BMD 03R[a]

Data Code[b]

X_1 = SALEPR

X_2 = QULINX

X_3 = QUNBLA

X_4 = AGEIMP

X_5 = DISTMP

X_6 = DISTUF

X_7 = AREA W

X_8 = NEIQL 2

X_9 = NEIQL 3

X_{10} = NEIQL 4

X_{11} = LOTSIZ

X_{12} = SITE 2

X_{13} = QUNAUX

X_{14} = DATE (Deleted)

X_{15} = DTMPSQ

X_{16} = DTUFSQ

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[a] W.J. Dixon, ed., BMD Biomedical Computer Programs, University of California Press, Berkeley, 1970.

[b] See Appendix A for description of each variable or acronym.

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BMD03R - MULTIPLE REGRESSION WITH CASE COMBINATIONS - REVISED OCTOBER 30. 1968
HEALTH SCIENCES COMPUTING FACILITY. UCLA


NO. OF SUBSAMPLES ........... 1
NO. OF ORIGINAL VARIABLES ...16
TOT. COMB. SAMP. SIZE ....  163
ALTERNATE TAPE NO. .......... 5
NO. OF VAR. FORMAT CARDS .... 2
THE VARIABLE FORMAT IS  14X.F5.0.14X.F3.0.8X.F4.0.F2.0.6X.F2.0.2X.F1.0.1X.F1.0.1X.F1.0.5X.
                        F5.0.1X.F1.0.3X.F3.0 / 21X.F3.0 / 27X.F3.0.3X.F2.0)

SELECTION NO.     1- 0
SUB-SAMPLES SELECTED   1


SUMS
      3341365.00000        17390.00000       211483.00000          870.00000         1324.00000         1111.00000
           69.00000           47.00000           12.00000           11.00000      1852303.00000           58.00000
        23673.00000        11815.00000        12552.00000         8259.00000


SUM OF SQUARES
   74355048447.99999      1863074.00000    295155200.00000        11742.00000        12552.00000         8259.00000
           69.00000           47.00000           12.00000           11.00000    22121365503.99999           59.00000
      4464477.00000      1252267.00000      1553736.00000       523335.00000


CROSS PRODUCT SUMS

ROW   1
   74355048447.99999    360482048.00000   4647845888.00000     17568672.00000     27889584.00000     21625088.00000
       1719184.00000      1002866.00000       343700.00000       405500.00000    39311216639.99999      1393141.00000
     525907200.00000    244784720.00000    266787472.00000    155306096.00000

ROW   2
     360482048.00000      1963074.00000     22732304.00000        91579.00000       141735.00000       117599.00000
          7605.00000         5074.00000         1347.00000         1274.00000    198751776.00000         6332.00000
       2556463.00000      1258277.00000      1345905.00000       870297.00000

ROW   3
    4647845888.00000     22732304.00000    295155200.00000      1172525.00000      1773237.00000      1368633.00000
        107249.00000        65618.00000        20555.00000        23523.00000   2469099520.00000        84351.00000
      32878560.00000     15679968.00000     17054224.00000      9812549.00000

ROW   4
      17568672.00000        91579.00000      1172525.00000        11742.00000         7705.00000         4748.00000
           541.00000          461.00000           70.00000           27.00000     10246797.00000          242.00000
        146959.00000        69934.00000        74513.00000        30542.00000

ROW   5
      27889584.00000       141735.00000      1773237.00000         7705.00000        12552.00000         8477.00000
           676.00000          470.00000          124.00000          100.00000     15351801.00000          489.00000
        205727.00000        98199.00000       134080.00000        59533.00000

ROW   6
      21625028.00000       117599.00000      1368633.00000         4748.00000         8477.00000         8259.00000
           363.00000          270.00000           61.00000           45.00000     12308417.00000          375.00000
     148736.00000      78998.00000      77373.00000      64669.00000

ROW    7
    1719184.00000       7605.00000     107249.00000        541.00000        676.00000        363.00000
         69.00000         37.00000         12.00000         11.00000     494583.00000         34.00000
      13230.00000       5105.00000       7164.00000       2155.00000

ROW    8
    1002866.00000       5074.00000      65618.00000        461.00000        470.00000        270.00000
         37.00000         47.00000          0.0              0.0         581925.00000         18.00000
       7725.00000       3740.00000       5340.00000       1738.00000

ROW    9
     343700.00000       1347.00000      20555.00000         70.00000        124.00000         61.00000
         12.00000          0.0             12.00000          0.0         164301.00000          7.00000
       2827.00000       1223.00000       1342.00000        341.00000

ROW   10
     405500.00000       1274.00000      23623.00000         27.00000        100.00000         45.00000
         11.00000          0.0              0.0             11.00000     156325.00000         10.00000
       2667.00000        829.00000        925.00000        191.00000

ROW   11
 39311216639.99999  198751776.00000 2469099520.00000   10245797.00000   15351801.00000   12308417.00000
     894588.00000     581925.00000     164301.00000     156325.00000 22121365503.99999     651950.00000
  279094272.00000  134852688.00000  147231856.00000   90130960.00000

ROW   12
    1393141.00000       6332.00000      84851.00000        242.00000        489.00000        375.00000
         34.00000         18.00000          7.00000         10.00000     681950.00000         58.00000
       9736.00000       4390.00000       4617.00000       2659.00000

ROW   13
  525907200.00000    2556463.00000   32378560.00000     146959.00000     205727.00000     148736.00000
      13230.00000       7725.00000       2327.00000       2667.00000  279094272.00000       9736.00000
    4464477.00000    1704980.00000    2026191.00000    1043464.00000

ROW   14
  244784720.00000    1258277.00000   15679968.00000      69934.00000      98199.00000      78998.00000
       5105.00000       3740.00000       1223.00000        829.00000  134852688.00000       4390.00000
    1704980.00000    1252267.00000     950519.00000     577820.00000

ROW   15
  266787472.00000    1345905.00000   17054224.00000      74513.00000     134080.00000      77373.00000
       7164.00000       5040.00000       1342.00000        926.00000  147231856.00000       4517.00000
    2026191.00000     950619.00000    1553736.00000     520569.00000

ROW   16
  155306096.00000     870297.00000    9312549.00000      30542.00000      59533.00000      54559.00000
       2155.00000       1738.00000        341.00000        191.00000   90130960.00000       2559.00000
    1043464.00000     577820.00000     520569.00000     523335.00000


CROSS PRODUCTS OF DEVIATIONS

ROW    1
 5859840000.00000    4001536.00000  312523104.00000    -265600.00000     748688.00000   -1149488.00000
     304742.00000      39405.00000      97710.06250     180009.18750 1340542975.00000      204190.00000
   40630528.00000    2587024.00000    9481588.00000  -13996560.00000
```

```
ROW    2
     4001536.00000        7786.00000      169808.00000       -1238.75000         481.31250        -930.31250
         243.58984          59.70703          66.75464         100.44189     1134944.00000         144.14844
       30860.00000       -2231.00000        6769.00000      -10831.81250

ROW    3
   312623104.00000      169808.00000    20768512.00000       43751.00000       55426.00000      -72824.00000
       17725.55250        4638.24219        4986.70312        9351.14453    65844735.00000        9599.43750
     2164240.00000      350695.00000      768737.00000      -903022.00000

ROW    4
     -265600.00000       -1238.75000       43751.00000        7098.44531         638.25391       -1181.87500
         172.71902         210.14111           5.95093         -31.71165      360274.00000         -67.57031
       20606.25000        6872.34375        7517.68750      -13539.77734

ROW    5
      748688.00000         481.31250       55425.00000         638.25391        1797.54587        -547.31641
         115.53394          88.23315          26.52752          10.65031      306102.00000          17.88354
       13438.43750        2229.31250       32123.93750       -7552.31250

ROW    6
    -1149488.00000        -930.31250      -72824.00000       -1181.87500        -547.31641         586.48047
        -107.30054         -50.34951         -20.79140         -29.97545     -316788.00000         -20.32495
      -12617.87500       -1532.43750       -9180.81250        8376.06250

ROW    7
      394742.00000         243.58984       17725.56250         172.71302         115.53394        -107.30054
          39.79141          17.10431           6.92025           6.34356      110484.37500           9.44786
        3208.91797         103.55859        1950.57812       -1341.14087

ROW    8
       39405.00000          59.70703        4638.24219         210.14111          88.23315         -50.34961
          17.10431          33.44785          -3.46012          -3.17178       47825.37500           1.27608
         899.04297         333.22095        1420.71157        -543.42944

ROW    9
       97710.06250          66.75464        4986.70312           5.95093          26.52762         -20.79140
           6.92025          -3.46012          11.11556          -0.80982       27935.18750           2.73005
        1084.20264         353.18408         417.92651        -267.02441

ROW   10
      180009.18750         100.44189        9351.14453         -31.71165          10.65031         -29.97545
           6.34356          -3.17178          -0.80982          10.25767       31323.00000           6.08589
        1069.43579          31.66895          78.93262        -366.35571

ROW   11
  1340542976.00000     1134944.00000    65844735.00000      360274.00000      306102.00000     -316788.00000
      110484.37500       47825.37500       27935.18750       31323.00000  1072132096.00000       22848.37500
    10078720.00000      589152.00000     4593184.00000     -3722816.00000

ROW   12
      204190.00000         144.14844        9599.43750         -67.57031          17.88354         -20.32495
           9.44786           1.27608           2.73006           6.08589       22848.37500          37.36197
        1312.48047         185.89062         150.64453        -279.78516

ROW   13
    40630528.00000       30860.00000     2164240.00000       20606.25000       13438.43750      -12617.87500
        3208.91797         899.04297        1084.20264        1069.43579    10078720.00000        1312.48047
     1026374.00000      -10948.00000      203226.00000      -156016.00000

ROW   14
```

```
        2587024.00000      -2231.00000      350595.00000       6872.34375       2229.31250      -1532.43750
          103.55859         333.22095          353.18438         31.66895     589152.00000        185.89062
       -10948.00000      395860.75000        40791.62500     -20830.75000

ROW  15
        9481888.00000       6769.00000      758737.00000       7517.68750      32123.93750      -8180.81250
          1850.57812        1420.71157          417.92651         78.93262    4593184.00000        150.64453
        203226.00000       40791.62500       587155.00000    -115424.56250

ROW  16
      -13996560.00000     -10831.81250     -903022.00000     -13539.77734      -7552.31250       8376.06250
          -1341.14087       -643.42944         -257.02441       -366.35571   -3722816.00000       -279.78515
        -156016.00000     -20830.75000     -115424.56250     104862.18750
```

```
SELECTION NO. .   1- 1


CORRELATION COEFFICIENTS

ROW    1
 1.000     0.4223     -.1666     0.1287     -.4324     0.4376     0.1170     0.2269     0.3554     0.3928     0.2673     0.3452
0.1001     -.3791     0.5924

ROW    2
0.4223      1.000     0.1139     0.2869     -.6099     0.5166     0.1760     0.3282     0.6407     0.4413     0.3446     0.4688
0.2201     -.6119     0.8961

ROW    3
-.1666     0.1139      1.000     0.1787     -.5354     0.3250     0.4313     0.2118E-01-.1175     0.1306     -.1312     0.2414
0.1164     -.4963     -.4118E-01

ROW    4
0.1287     0.2869     0.1787      1.000     -.4927     0.4320     0.3598     0.1877     0.7843E-010.2205     0.6901E-010.3129
0.9888     -.5501     0.2307

ROW    5
-.4024     -.6099     -.5354     -.4927      1.000     -.6492     -.3323     -.2380     -.3572     -.3693     -.1269     -.4754
-.4075     0.9872     -.5731

ROW    6
0.4376     0.6166     0.3250     0.4320     -.6492      1.000     0.4688     0.3290     0.3140     0.5349     0.2450     0.5021
0.3823     -.6566     0.6311

ROW    7
0.1170     0.1760     0.4313     0.3598     -.3323     0.4688      1.000     -.1794     -.1712     0.2526     0.3610E-010.1534
0.3206     -.3436     0.8901E-01

ROW    8
0.2269     0.3282     0.2118E-010.1877     -.2380     0.3290     -.1794      1.000     -.7584E-010.2559     0.1340     0.3210
0.1636     -.2473     0.3828

ROW    9
0.3554     0.6407     -.1175     0.7843E-01-.3572     0.3140     -.1712     -.7584E-01 1.000     0.2987     0.3109     0.3296
0.3216E-01-.3532     0.7342

ROW   10
0.3928     0.4413     0.1306     0.2205     -.3693     0.5349     0.2526     0.2559     0.2987      1.000     0.1142     0.3038
0.1831     -.3511     0.5348

ROW   11
0.2673     0.3446     -.1312     0.6901E-01-.1269     0.2450     0.3610E-010.1340     0.3109     0.1142      1.000     0.2119
0.3216E-01-.1414     0.4364

ROW   12
0.3452     0.4688     0.2414     0.3129     -.4754     0.5021     0.1534     0.3210     0.3296     0.3038     0.2119      1.000
0.2618     -.4756     0.5239

ROW   13
0.1001     0.2201     0.1164     0.9888     -.4075     0.3329     0.3206     0.1636     0.3216E-010.1831     0.3216E-010.2618
 1.000     -.4652     0.1616

ROW   14
-.3791     -.6119     -.4963     -.5501     0.9872     -.6566     -.3436     -.2473     -.3532     -.3511     -.1414     -.4756
-.4652      1.000     -.5646
```

```
ROW  15
0.5924   0.8961   -.4118E-010.2407   -.5731   0.5311   0.8931E-010.3828   0.7342   0.5348   0.4364   0.5239
0.1616   -.5646    1.000

INVERSE OF CORRELATION COEFFICIENT MATRIX

ROW   1
 2.169   0.3649    1.389    1.136    4.220   -.2495   -.5546   -.3078   -.2539   -.2382   -.1642   -.2979
-.7679   -2.933

ROW   2
0.3649    3.660   0.5308   0.6556    1.530   -.2703   -1.122   -1.318   -2.155   -.3164E-01-.2167   -.4226E-01
-.3311   -.3746

ROW   3
 1.389   0.5308    3.082   -2.855    6.559   -.3920   -.7071   -.8783E-020.3955   0.5445E-020.1939   -.3959
 3.146   -4.724

ROW   4
 1.136   0.6556   -2.855    112.5   -12.53    5.636   -5.957   -4.062   -4.670   -1.105   -2.471   -1.199
-104.5    22.73

ROW   5
 4.220    1.530    6.559   -12.53    63.73   -1.152   -1.773   -.8625   0.5658E-02 1.392   -.4088   -.1653
 9.489   -60.82

ROW   6
-.2495   -.2703   -.3920    5.636   -1.152    3.383   -1.351   -.8970   -.7159   -.5485   -.2562   -.2984
-5.401    2.179

ROW   7
-.5546   -1.122   -.7071   -5.957   -1.773   -1.361    3.151    1.817    2.007   -.3113   -.3280E-010.3078E-01
 5.158   0.8730

ROW   8
-.3078   -1.318   -.8784E-02-4.062   -.8625   -.8970    1.317    2.565    2.037   -.3512   -.5309E-01-.3440
 3.642   0.4783

ROW   9
-.2539   -2.155   0.3955   -4.670   0.5636E-02-.7159    2.007    2.037    3.758   -.4238   -.1707   -.3872
 4.413   -.4684E-01

ROW  10
-.2382   -.3164E-010.5445E-02-1.105    1.392   -.5485   -.3113   -.3512   -.4238    1.632   0.1760   0.8189E-01
0.9473   -1.715

ROW  11
-.1642   -.2167   0.1939   -2.471   -.4088   -.2562   -.3280E-01-.5309E-01-.1707   0.1760    1.303   -.4430E-01
 2.393   0.3081E-01

ROW  12
-.2979   -.4226E-01-.3959   -1.199   -.1653   -.2984   0.3078E-01-.3440   -.3872   0.8189E-01-.4430E-01 1.636
0.9323   -.4351E-02

ROW  13
-.7579   -.3311    3.146   -104.5    9.489   -5.401    5.158    3.642    4.413   0.9473    2.393   0.9323
 98.79   -18.04

ROW  14
```

```
-2.933    -.3746   -4.724    22.73    -60.82     2.179    0.8730    0.4783    -.4686E-01-1.715    0.3081E-01-.4340E-02
-18.04     62.70
```

```
SELECTION NO.,   1- 1

SAMPLE SIZE      163
NO. OF VARIABLES 15       NO. OF VARIABLES DELETED  1   (FOR VARIABLES DELETED, SEE BELOW)
DEPENDENT VARIABLE IS NOW NO.  1

COEFFICIENT OF DETERMINATION  0.9519
MULTIPLE CORR. COEFFICIENT    0.9757

SUM OF SQUARES ATTRIBUTABLE TO REGRESSION  ***************
SUM OF SQUARES OF DEVIATION FROM REGRESSION281698304.00000

VARIANCE OF ESTIMATE  ************
STD. ERROR OF ESTIMATE  1379.62524

INTERCEPT (A VALUE)  4918.86719


               ANALYSIS OF VARIANCE FOR THE MULTIPLE
                      LINEAR  REGRESSION
      SOURCE OF VARIATION     D.F.      SUM OF          MEAN          F
                                        SQUARES        SQUARES      VALUE
DUE TO REGRESSION............  14*****************************   209.3337
DEVIATION ABOUT REGRESSION... 148281698304.00000 1903366.00000
               TOTAL...       162***************


VARIABLE     MEAN         STD.         REG.       STD.ERROR     COMPUTED    PARTIAL      SUM OF SQ.   PROP. VAR.
  NO.                  DEVIATION     COEFF.     OF REG.COE.   T VALUE    CORR. COE.     ADDED        CUM.
   2      106.68710     6.93266     55.19995     23.02679     2.39720    0.19346***************      0.35096
   3     1297.44165   358.05103      6.98020      0.57918    12.05186    0.70399***************      0.50784
   4        5.33742     6.61948  -194.20630     28.74516    -6.75614   -0.48572 48048416.00000      0.00820
   5        8.12270     3.33106   940.34766    345.11011     2.72479    0.21879  1369444.00000      0.00023
   6        6.81595     2.05853-1947.87500    420.34155    -4.63403   -0.35619 34964480.00000      0.00597
   7        0.42331     0.49561   806.78515    402.26978     2.00558    0.16275 49375808.00000      0.00936
   8        0.28834     0.45439  1372.93359    423.45093     3.24225    0.25766 21627120.00000      0.00369
   9        0.07362     0.26196  4476.23437    662.73242     6.75421    0.48562  9333305.00000      0.00159
  10        0.05748     0.25163  7713.77344    835.02124     9.23792    0.60497277930752.00000      0.04743
  11    11363.82031  2572.56641     0.16927      0.05383     3.14433    0.25038 22669952.00000      0.00387
  12        0.35583     0.48024   797.74975    257.68896     3.09579    0.24675 26969056.00000      0.00460
  13      145.23312    79.59673     4.03871      1.74190     2.31856    0.18732 11807085.00000      0.00201
  15       77.00613    60.20309   -54.96631     17.89500    -3.07160   -0.24493  8952324.00000      0.00153
  16       50.66870    25.44203   141.33203     33.73579     4.18938    0.32578 33402400.00000      0.00570
   1    20499.16797  6014.30078

COMP. CHECK ON FINAL COEFF.       141.30753


VARIABLES DELETED... 14
```

APPENDIX E

Abridged Computer Print-out of Matrices, Statistics and Graph of Actual Versus Predicted Sale Price for the Selected Multiple Regression Equation, Based on Program ECON[a]

Data Code

The variables in the equation are coded by acronyms. See Appendix A for a description of each variable.

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[a] The original ECON regression program was written by Mr. M.R. Norman of M.I.T.

```
            18 AUGUST 1971
EQUATION NUMBER        15
MODEL CONTAINS  163 OBSERVATIONS. EQUATION CONTAINS 15 VARIABLES
  0  0  0 15 15 39 11 16 33 35 28 29 30 24 17 22 20 25  1  1  1  0  0

SUM OF SQUARES AND CROSS PRODUCTS MATRIX


              1            2            3            4            5            6            7            8            9           10
  1*************32879092.00022732595.000 1172525.000*************   84851.000    65618.000    20555.000    23623.000 1358633.000
  232879092.000 4464477.000 2556463.000  146959.000*************    9736.000     7725.000     2827.000     2667.000  148736.000
  322732595.000 2556463.000 1863074.000   91579.000*************    6332.000     5074.000     1347.000     1274.000  117599.000
  4 1172525.000  146959.000   91579.000   11742.00010246797.000      242.000      461.000       70.000       27.000    4743.000
  5*************************************10246797.000*************  681950.000   581925.000   164301.000   156325.00012308417.000
  6    84851.000    9736.000    6332.000     242.000   581950.000       58.000       18.000        7.000       10.000     375.000
  7    65618.000    7725.000    5074.000     451.000   581925.000       18.000       47.000        0.0          0.0       270.000
  8    20556.000    2827.000    1347.000      70.000   164301.000        7.000        0.0         12.000        0.0        51.000
  9    23623.000    2667.000    1274.000      27.000   156325.000       10.000        0.0          0.0         11.000      45.000
 10 1368633.000  148736.000  117599.000    4748.00012308417.000      375.000      270.000       61.000       45.000    8259.000
 11 9812549.000 1043464.000  870297.000   30542.00090131491.000     2659.000     1738.000      341.000      191.000   54559.000
 12 1773237.000  205727.000  141735.000    7705.00015351801.000      489.000      470.000      124.000      100.000    8477.000
 1317054263.000 2026191.000 1345905.000   74513.000*************    4617.000     5040.000     1342.000      926.000   77373.000
 14   107249.000   13230.000    7605.000     541.000   094588.000       34.000       37.000       12.000       11.000     363.000
 15*************************************1756869.000************* 1393141.000 1002866.000   343700.000   405500.00021625205.000


             11           12           13           14           15
  1 9812549.000 1773237.00017054263.000  107249.000*************
  2 1043464.000  205727.000 2026191.000   13230.000*************
  3   870297.000 141735.000 1345905.000    7605.000*************
  4    30542.000   7705.000   74513.000     541.00017553699.000
  590131491.00015351801.000*************  894588.000*************
  6     2659.000    489.000    4617.000      34.000 1393141.000
  7     1738.000    470.000    5040.000      37.000 1002866.000
  8      341.000    124.000    1342.000      12.000  343700.000
  9      191.000    100.000     926.000      11.000  405500.000
 10    64669.000   8477.000   77373.000     363.00021625205.000
 11   523335.000  59533.000  520569.000    2155.000*************
 12    59533.000  12552.000  134080.000     676.00027389975.000
 13   520569.000 134080.000 1553736.000    7154.000*************
 14     2155.000    676.000    7164.000      59.000 1719184.000
 15*************27389975.000************* 1719134.000*************

ORDINARY LEAST SQUARES


DETERMINANT=       0.40018611D 51
     VARIANCE-COVARIANCE MATRIX OF COEFFICIENT

     0.298280
     0.015689     3.005491
    -1.983166    -3.043818   162.945331
    -0.410002    -6.123534    54.194631   579.192733
    -0.000991     0.005219    -0.215448    -0.044158     0.002889
    -7.358940   -20.279305   161.926094  1324.908271     1.791092 64928.520562
   -48.908733   -18.692632  1130.081319  -139.172424    -2.623597 -8212.157937151566.695877
  -126.177538  -228.601190  1883.542144  3118.593334    -5.511966-12759.608262145740.810130398605.823407
  -239.568541  -264.222983  2430.691731  6185.855818    -7.039884-24923.900600170395.175034319724.157227651046.897083
```

```
-19.930963    26.789391   -824.817774  2130.108765       2.413325   3820.592952 15134.748661 26495.575418 48490.297046126460.294214
  1.935969    -2.093946     34.657257  -140.918458      -3.271966   -435.057312 -1114.868722 -1580.892015 -2675.144348-10953.626260
904.729231
-20.367891   -29.039543 -2101.954172 -3719.599437      -1.935970-12749.464037-22975.289954-26567.417400-35482.104782-32951.737749
4832.280056 99577.414696
  1.139870     1.100095    110.122512   200.978054      0.092539    706.604940  1069.910213  1328.329182  1947.157703  2445.070931
-221.161515 -5161.884752    272.898332
-18.596410   -88.179787  -930.209949 -1456.841186      -5.065103-12496.048088-75378.627979-80437.838807-66651.117584-14198.066249
2081.082200 39535.043290 -2098.346776161834.598893

 DEPENDENT VARIABLE      SALEPR

  A(QUNBLA  )=      7.22154047      T= 13.223
           (        0.54615051)

  A(QUNAUX  )=      3.82033457      T=  2.204
           (        1.73363495)

  A(QULINX  )=     79.63424338      T=  6.238
           (       12.76500416)

  A(AGEIMP  )=   -174.57038400      T= -7.254
           (       24.06642151)

  A(LOTSIZ  )=      0.17255485      T=  3.210
           (        0.05375154)

  A(SITE 2  )=    745.86890895      T=  2.927
           (      254.81076050)

  A(NEIQL2  )=   1156.38301813      T=  2.970
           (      389.31567383)

  A(NEIQL3  )=   4214.56640972      T=  6.675
           (      631.35229492)

  A(NEIQL4  )=   7433.97769159      T=  9.213
           (      806.87475586)

  A(DISTUF  )=  -1666.35913955      T= -4.686
           (      355.61254883)

  A(DTUFSQ  )=    126.46805713      T=  4.010
           (       31.53932190)

  A(DISTMP  )=   1133.57943473      T=  3.592
           (      315.55883789)
```

```
A(DTMPSQ   )=    -64.52113262       T= -3.906
               (    16.51933289)

A(AREA W   )=    817.12718292       T=  2.031
               (   402.28662109)
```

```
ANALYSIS OF VARIANCE TABLE
-------- -- -------- -----

SOURCE              SUM OF SQUARES      DEGREES OF FREEDOM  MEAN SQUARE

REGRESSION          **************             14           ***********

  A0                **************              0           ***********

  REGRESSION-A0     **************             14           ***********

RESIDUAL            283688960.0000            149           ***********

TOTAL               **************            163


VARIANCE =            ***************

STANDARD DEVIATION =  1379.83764648

R-SQUARED =                  0.9474      (ADJUSTED FOR DEGREES OF FREEDOM)

R-SQUARED =                  0.9516      (UNADJUSTED)

F-TEST( 14,149) =          209.2257

DURBIN-WATSON STATISTIC =   1.93734
```

```
15 SALEPR      R/SE        D/F       QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTJF
3_S          0.9474     1.9373     7.2213     3.8233    79.6342  -174.5704     0.1726   745.8689  1155.3830  4214.5564  7433.9777-1656.3591
          1379.8376   209.2257    13.2226     2.2037     5.2385    -7.2537     3.2192     2.9271     2.9703     6.6755     9.2133    -4.6857

                                 DTUFSQ     DISTMP     DTMPSQ     AREA #
                               126.4681  1133.5794   -64.5211   817.1272
                                 4.0099     3.5923    -3.9058     2.0312

      ACTUALS(*)    PREDICTED(+)    RESIDUALS     UNIT NORMAL                                         RANGE 14136.85   TO 43000.00


     15000.000      16560.582     -1560.582         -1.131   1  .  *  +                                                         .
     15000.000      15523.594      -523.594         -0.379   2  .  *+                                                           .
     15000.000      16107.270     -1107.270         -0.902   3  .  * +                                                          .
     15000.000      14752.250       247.750          0.180   4  . +*                                                            .
     15200.000      14136.852      1063.148          0.770   5  .+ *                                                            .
     15200.000      14748.293       451.707          0.327   6  . +*                                                            .
     15300.000      17430.949     -2130.949         -1.544   7  .  *    +                                                       .
     15400.000      15729.078      -329.078         -0.238   8  .   +                                                           .
     15400.000      16065.293      -665.293         -0.482   9  .   *+                                                          .
     15500.000      16644.875     -1144.875         -0.830  10  .   * +                                                         .
     15500.000      16594.848     -1094.848         -0.793  11  .   * +                                                         .
     15500.000      15142.957       357.043          0.259  12  .  +*                                                           .
     15500.000      16098.387      -598.387         -0.434  13  .   *+                                                          .
     15500.000      15699.129      -199.129         -0.144  14  .   +                                                           .
     15500.000      15848.355      -348.355         -0.252  15  .   +                                                           .
     15600.000      15924.008      -324.008         -0.235  16  .   *+                                                          .
     15700.000      15697.578         2.422          0.002  17  .   +                                                           .
     15700.000      15917.461      -217.461         -0.158  18  .   *+                                                          .
     15800.000      16014.578      -214.578         -0.156  19  .   *+                                                          .
     15900.000      15192.781       707.219          0.513  20  .  + *                                                          .
     16000.000      14557.730      1442.270          1.045  21  . +  *                                                          .
     16000.000      17086.164     -1086.164         -0.787  22  .    * +                                                        .
     16000.000      15229.145       770.855          0.559  23  .  + *                                                          .
     16049.000      17157.563     -1108.563         -0.803  24  .    * +                                                        .
     16050.000      16819.059      -769.059         -0.557  25  .    *+                                                         .
     16100.000      16128.945       -28.945         -0.021  26  .    +                                                          .
     16116.000      16641.094      -525.094         -0.381  27  .    *+                                                         .
     16200.000      15798.113       401.887          0.291  28  .   +*                                                          .
     16200.000      17175.352      -975.352         -0.707  29  .    * +                                                        .
     16250.000      19493.535     -3243.535         -2.351  30  .    *     +                                                    .
     16300.000      16091.141       208.859          0.151  31  .    +                                                          .
     16300.000      15813.102       486.898          0.353  32  .   +*                                                          .
     16300.000      17355.711     -1055.711         -0.765  33  .    * +                                                        .
     16300.000      16258.840        41.160          0.030  34  .    +                                                          .
     16400.000      16091.141       308.859          0.224  35  .    +*                                                         .
     16500.000      16575.168       -75.168         -0.054  36  .     +                                                         .
     16500.000      15760.340       739.660          0.536  37  .   + *                                                         .
     16500.000      14356.148      2143.852          1.554  38  .+    *                                                         .
     16500.000      17611.027     -1111.027         -0.805  39  .     * +                                                       .
     16500.000      17239.109      -739.109         -0.536  40  .     *+                                                        .
     16500.000      17065.496      -565.496         -0.410  41  .     *+                                                        .
     16500.000      17065.496      -565.496         -0.410  42  .     *+                                                        .
     16500.000      16865.160      -365.150         -0.265  43  .     *+                                                        .
     16500.000      16865.160      -365.160         -0.265  44  .     *+                                                        .
     16500.000      16822.180      -322.180         -0.233  45  .     +                                                         .
     16500.000      17024.426      -524.426         -0.380  46  .     *+                                                        .
     16500.000      16865.160      -365.160         -0.265  47  .     *+                                                        .
     16500.000      16972.992      -472.992         -0.343  48  .     *+                                                        .
```

```
16500.000     16822.180      -322.180     -0.233   49
16500.000     16693.711      -193.711     -0.140   50
16500.000     17682.504     -1182.504     -0.857   51
16600.000     16966.848      -366.848     -0.265   52
16600.000     16789.016      -189.016     -0.137   53
16750.000     16897.309      -147.309     -0.107   54
16800.000     19958.789     -3158.789     -2.289   55
16900.000     16033.168       866.832      0.628   56
17100.000     16961.070       138.930      0.101   57
17200.000     16919.648       280.352      0.203   58
17200.000     18021.293      -821.293     -0.595   59
17200.000     17460.488      -260.488     -0.189   60
17208.000     17534.664      -326.664     -0.237   61
17300.000     17957.895      -657.895     -0.477   62
17300.000     19026.949     -1726.949     -1.252   63
17300.000     17077.422       222.578      0.161   64
17300.000     17137.121       162.879      0.118   65
17300.000     17137.121       162.879      0.118   66
17300.000     17137.121       162.879      0.118   67
17300.000     17010.238       289.762      0.210   68
17300.000     17038.980       261.020      0.189   69
17300.000     17841.922      -541.922     -0.393   70
17300.000     16936.785       363.215      0.263   71
17300.000     16859.426       440.574      0.319   72
17300.000     16859.426       440.574      0.319   73
17300.000     16859.426       440.574      0.319   74
17300.000     16086.652      1213.348      0.879   75
17500.000     16014.148      1485.852      1.077   76
17500.000     18079.375      -579.375     -0.420   77
17700.000     17150.496       549.504      0.398   78
17700.000     16834.316       865.684      0.627   79
17700.000     17269.043       430.957      0.312   80
17750.000     17986.797      -236.797     -0.172   81
17875.000     17868.609         6.391      0.005   82
18000.000     18046.926       -46.926     -0.034   83
18000.000     20695.336     -2695.336     -1.953   84
18100.000     18605.555      -505.555     -0.366   85
18100.000     19365.168     -1265.168     -0.917   86
18100.000     19491.031     -1391.031     -1.008   87
18500.000     20730.313     -2230.313     -1.616   88
18500.000     16603.500      1896.500      1.374   89
18600.000     18943.852      -343.852     -0.249   90
18600.000     18976.809      -376.809     -0.273   91
18600.000     19329.879      -729.879     -0.529   92
18600.000     18780.293      -180.293     -0.131   93
18600.000     18748.777      -148.777     -0.108   94
18600.000     18748.777      -148.777     -0.108   95
18600.000     19526.160      -926.160     -0.671   96
19000.000     21081.652     -2081.652     -1.509   97
19200.000     16734.211      2465.789      1.787   98
19300.000     17825.613      1474.387      1.069   99
19500.000     18302.293      1197.707      0.868  100
19700.000     19952.898      -252.898     -0.183  101
19800.000     17436.449      2363.551      1.713  102
20000.000     22889.250     -2889.250     -2.094  103
20400.000     17321.098      3078.902      2.231  104
20500.000     21144.559      -644.559     -0.467  105
20500.000     18665.504      1834.496      1.330  106
20500.000     19629.789       870.211      0.631  107
20817.000     21610.930      -793.930     -0.575  108
21000.000     19630.836      1369.164      0.992  109
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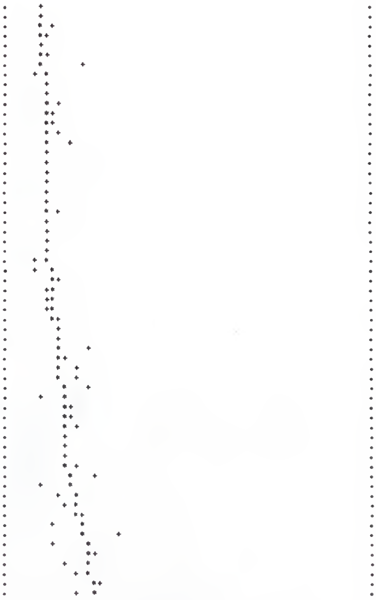

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21000.000    19703.680    1296.320     0.939  110
21000.000    21279.539    -279.539    -0.203  111
21000.000    22100.516   -1100.516    -0.799  112
21000.000    18600.180    2399.820     1.739  113
21250.000    22813.922   -1563.922    -1.133  114
21500.000    24799.645   -3299.645    -2.391  115
21500.000    18895.047    2604.953     1.888  116
21500.000    24177.910   -2677.910    -1.941  117
21500.000    22583.063   -1083.063    -0.785  118
21867.000    23019.203   -1152.203    -0.835  119
22000.000    20869.773    1130.227     0.819  120
22000.000    19953.320    2046.680     1.483  121
22100.000    19816.051    2283.949     1.655  122
22500.000    19764.367    2735.633     1.983  123
22500.000    21472.543    1027.457     0.745  124
22500.000    20370.449    2129.551     1.543  125
22733.000    21708.996    1024.004     0.742  126
22900.000    23101.098    -201.098    -0.146  127
23000.000    26026.441   -3026.441    -2.193  128
23000.000    23041.160     -41.160    -0.030  129
23000.000    23125.160    -125.160    -0.091  130
23500.000    23217.270     282.730     0.205  131
23500.000    26015.867   -2515.867    -1.823  132
23750.000    21597.785    2152.215     1.560  133
23800.000    23533.996     266.004     0.193  134
25000.000    25105.141    -105.141    -0.076  135
25700.000    21572.781    4127.219     2.991  136
25800.000    25235.465     564.535     0.409  137
26000.000    26931.125    -931.125    -0.675  138
26500.000    25957.316     542.684     0.393  139
26600.000    26399.297     200.703     0.145  140
26700.000    25265.887    1434.113     1.039  141
27100.000    27555.711    -455.711    -0.330  142
27500.000    28864.445   -1364.445    -0.988  143
28000.000    26899.227    1100.773     0.798  144
28100.000    24585.852    3514.148     2.547  145
29000.000    27866.926    1133.074     0.821  146
30000.000    33218.781   -3218.781    -2.333  147
30000.000    30123.270    -123.270    -0.089  148
31000.000    30505.684     494.316     0.358  149
31500.000    29682.406    1817.594     1.317  150
32000.000    31314.766     685.234     0.497  151
32500.000    31570.566     929.434     0.674  152
33000.000    31897.723    1102.277     0.799  153
35000.000    35546.758    -546.758    -0.396  154
35000.000    36332.754   -1332.754    -0.966  155
35000.000    36127.914   -1127.914    -0.817  156
36000.000    35598.078     401.922     0.291  157
37000.000    36455.941     544.059     0.394  158
37500.000    37468.395      31.605     0.023  159
38000.000    35208.852    2791.148     2.023  160
38000.000    37703.676     296.324     0.215  161
41000.000    39386.070    1613.930     1.170  162
43000.000    42452.547     547.453     0.397  163
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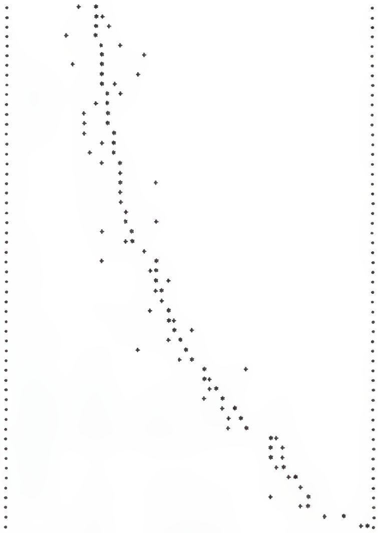


APPENDIX F

Abridged Computer Print-out of Plot of Residuals Against Actual Sale Price, All Regressors in the Selected Multiple Regression Equation and a Time Variable, Based on Program BMD 02R[a]

Data Code[b]

X_1 = SALEPR

X_2 = QULINX

X_3 = QUNBLA

X_4 = AGEIMP

X_5 = DISTMP

X_6 = DISTUF

X_7 = AREA W

X_8 = NEIQL 2

X_9 = NEIQL 3

X_{10} = NEIQL 4

X_{11} = LOTSIZ

X_{12} = SITE 2

X_{13} = QUNAUX

X_{14} = DATE

X_{15} = DTMPSQ

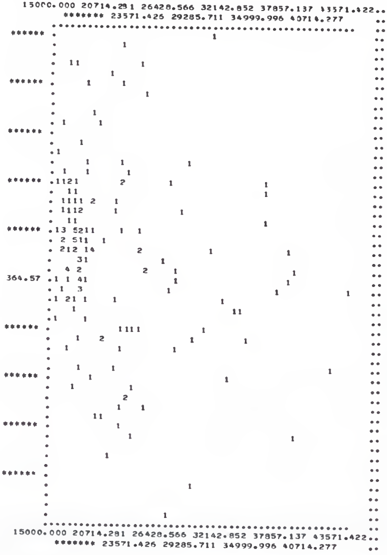
X_{16} = DTUFSQ

---

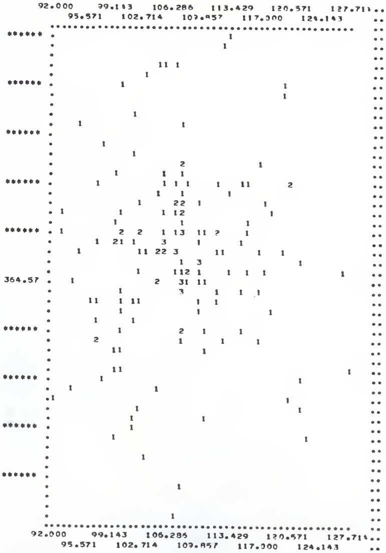
[a] W.J. Dixon, ed., BMD Biomedical Computer Programs, University of California Press, Berkeley, 1970.

[b] See Appendix A for description of each variable or acronym.

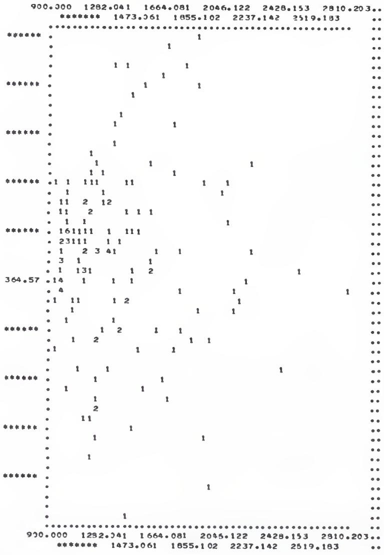
PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 1 (X-AXIS)



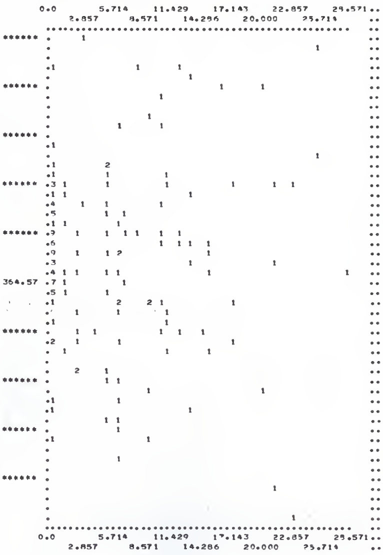
PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 2 (X-AXIS)



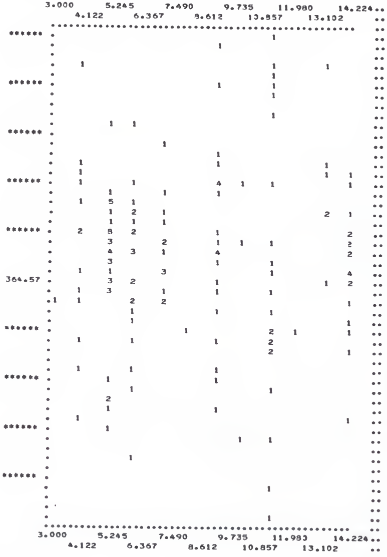
P_OT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 3 (X-AXIS)



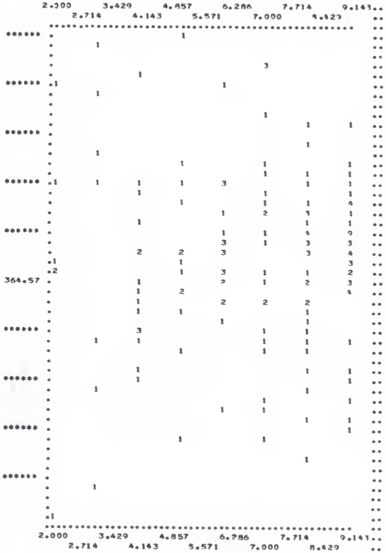
PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 4 (X-AXIS)



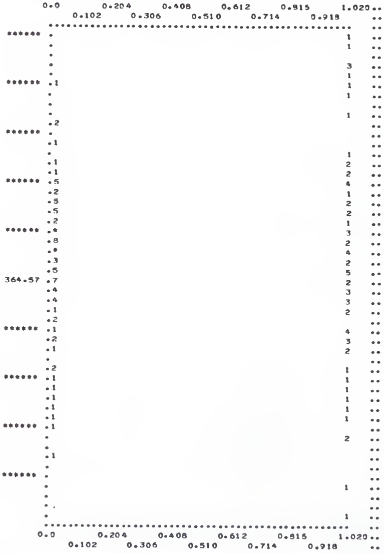
PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 5 (X-AXIS)



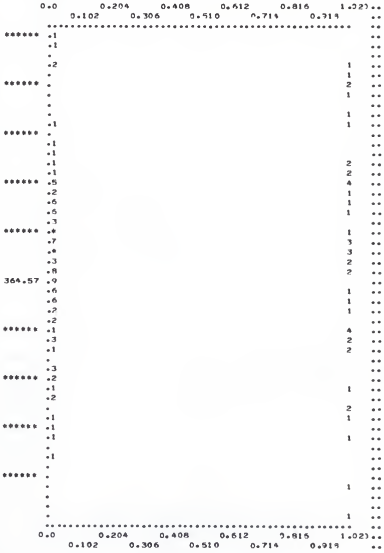
PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 6 (X-AXIS)



PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 7 (X-AXIS)



PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 8 (X-AXIS)

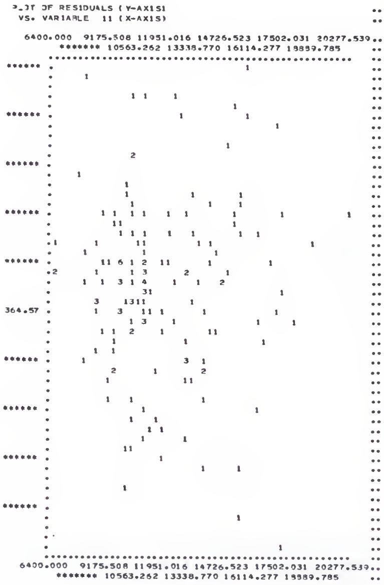


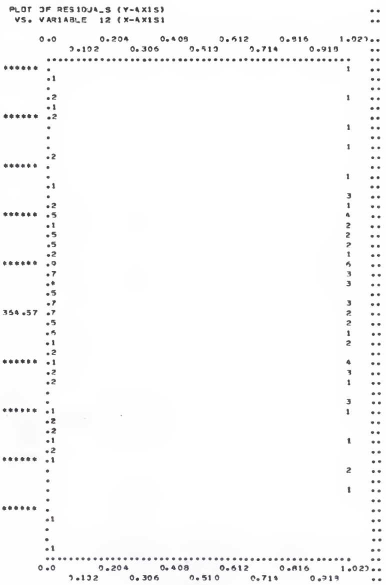
```
 PLOT OF RESIDUALS (Y-AXIS)                                   ..
  VS. VARIABLE   9 (X-AXIS)                                   ..

      0.0      0.204     0.408     0.612     0.816       1.020..
          0.102     0.306     0.510     0.714     0.918       ..
       ...................................................    ..
****** .1                                                     ..
       .                                                 1    ..
       .                                                      ..
       .2                                                1    ..
       .1                                                     ..
****** .2                                                     ..
       .1                                                     ..
       .                                                      ..
       .1                                                     ..
       .2                                                     ..
****** .                                                      ..
       .1                                                     ..
       .1                                                     ..
       .3                                                     ..
       .3                                                     ..
****** .9                                                     ..
       .3                                                     ..
       .7                                                     ..
       .6                                                1    ..
       .3                                                     ..
****** .*                                                     ..
       .*                                                     ..
       .*                                                1    ..
       .5                                                     ..
       .9                                                1    ..
364.57 .8                                                1    ..
       .7                                                     ..
       .6                                                1    ..
       .1                                                2    ..
       .2                                                     ..
****** .4                                                1    ..
       .4                                                1    ..
       .3                                                     ..
       .                                                      ..
       .3                                                     ..
****** .1                                                1    ..
       .2                                                     ..
       .2                                                     ..
       .2                                                     ..
       .2                                                     ..
****** .1                                                     ..
       .2                                                     ..
       .                                                      ..
       .1                                                     ..
       .                                                      ..
****** .                                                      ..
       .1                                                     ..
       .                                                      ..
       .                                                      ..
       .1                                                     ..
       ...................................................    ..
      0.0      0.204     0.408     0.612     0.816       1.020..
          0.102     0.306     0.510     0.714     0.918       ..
```

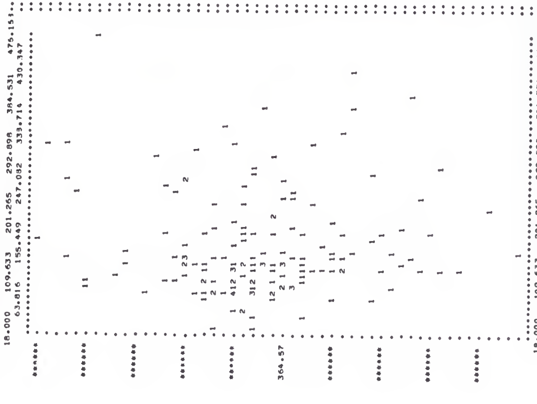
```
 PLOT OF RESIDUALS (Y-AXIS)                                   ..
  VS. VARIABLE  10 (X-AXIS)                                   ..

      0.0      0.204     0.408     0.612     0.816       1.020..
          0.102     0.306     0.510     0.714     0.918       ..
       ...................................................    ..
****** .                                                 1    ..
       .1                                                     ..
       .                                                      ..
       .3                                                     ..
       .1                                                     ..
****** .2                                                     ..
       .1                                                     ..
       .                                                      ..
       .1                                                     ..
       .2                                                     ..
****** .                                                      ..
       .1                                                     ..
       .1                                                     ..
       .3                                                     ..
       .3                                                     ..
****** .8                                                1    ..
       .2                                                1    ..
       .7                                                     ..
       .7                                                     ..
       .2                                                1    ..
****** .*                                                     ..
       .*                                                     ..
       .*                                                1    ..
       .5                                                     ..
       .9                                                1    ..
364.57 .8                                                1    ..
       .5                                                2    ..
       .7                                                     ..
       .3                                                     ..
       .2                                                     ..
****** .5                                                     ..
       .5                                                     ..
       .3                                                     ..
       .                                                      ..
       .2                                                1    ..
****** .2                                                     ..
       .2                                                     ..
       .2                                                     ..
       .2                                                     ..
       .2                                                     ..
****** .1                                                     ..
       .1                                                1    ..
       .                                                      ..
       .1                                                     ..
       .                                                      ..
****** .                                                      ..
       .1                                                     ..
       .                                                      ..
       .                                                      ..
       .1                                                     ..
       ...................................................    ..
      0.0      0.204     0.408     0.612     0.816       1.020..
          0.102     0.306     0.510     0.714     0.918       ..
```

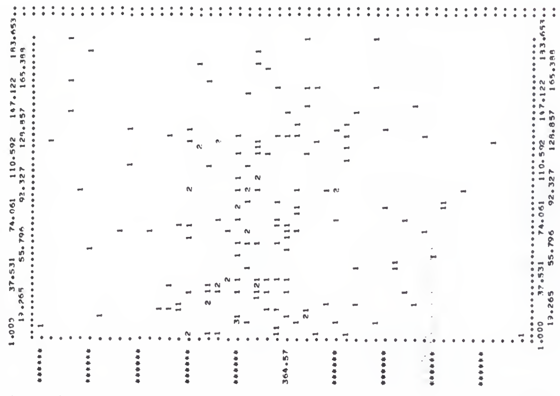

P_OT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 11 (X-AXIS)
6400.000 9175.508 11951.016 14726.523 17502.031 20277.539
******* 10563.262 13338.770 16114.277 18889.785
364.57


PLOT OF RESIDUA_S (Y-AXIS)
VS. VARIABLE 12 (X-AXIS)
0.0 0.204 0.408 0.612 0.816 1.020
0.102 0.306 0.510 0.714 0.918
354.57

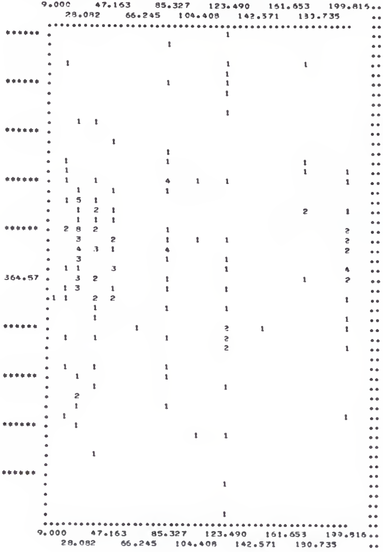
P_OT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 13 (X-AXIS)



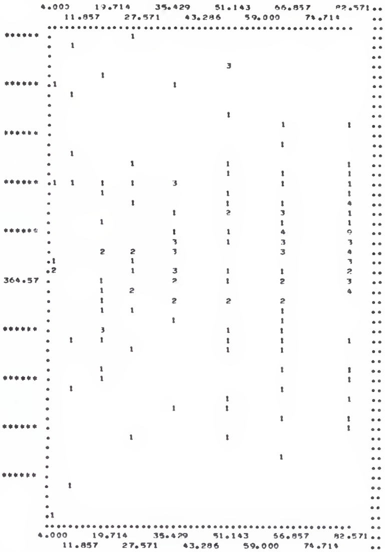
PLOT OF RESIDUA_S (Y-AXIS)
VS. VARIAB_E 14 (X-AXIS)

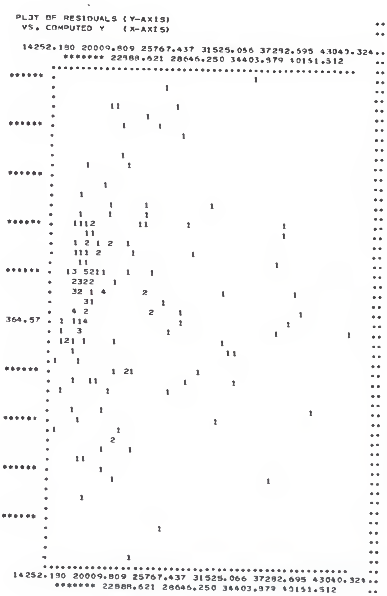


PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 15 (X-AXIS)



PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 16 (X-AXIS)




PLOT OF RESIDUALS (Y-AXIS)
VS. COMPUTED Y (X-AXIS)
14252.180 20009.809 25767.437 31525.056 37292.595 43040.324
******* 22988.621 28646.250 34403.979 40151.512
364.57
14252.190 20009.809 25767.437 31525.066 37282.695 43040.324
******* 22888.621 28646.250 34403.979 40151.512

APPENDIX G

Abridged Computer Print-out of Summary of Results for Key Regression Equations, Based on Program ECON[a]

Data Code

The variables in the equations are coded by acronyms. See Appendix A for a description of each variable.

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[a] The original ECON regression program was written by Mr. M.R. Norman of M.I.T.

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            18 AUGUST 1971
SUMMARY OF RESULTS

  1 SALEPR      R/SE       D/F         DUNBLA      CONS
  OLS             0.8019    0.0         15.0533   968.0697
               2677.1125  656.7378     25.6271      1.2247

  2 SALEPR      R/SE       D/F         DUNAUX      CONS
  3LS             0.2701    0.0         39.598414748.1707
               5139.6367   60.9480      7.8070     17.5692

  3 SALEPR      R/SE       D/F         DULINX      CONS
  OLS             0.3479    0.0        514.7282**********
               4857.0391   87.4302      9.3505     -5.8478

  4 SALEPR      R/SE       D/F         AGEIMP      CONS
  3LS            -0.0045    0.0        -37.413920698.8656
               6028.2617    0.2734     -0.5229     34.0846

  5 SALEPR      R/SE       D/F         LOTSIZ      CONS
  OLS             0.2816    0.0          1.2503  6290.5904
               5097.9180   64.5077      8.0317      3.4686

  6 SALEPR      R/SE       D/F         SITE 2      CONS
  3LS             0.1854    0.0       5465.158119554.5143
               5428.6953   37.8640      6.1535     35.0226

  7 SALEPR      R/SE       D/F         NEIOL2      CONS
  OLS             0.0018    0.0       1178.100320159.4741
               6009.4375    1.2855      1.1338     36.1305

  8 SALEPR      R/SE       D/F         NEIOL3      CONS
  3LS             0.1412    0.0       8789.580519852.0861
               5573.8320   27.6424      5.2577     43.7564

  9 SALEPR      R/SE       D/F         NEIOL4      CONS
  OLS             0.5361    0.0      17548.735019314.9013
               4096.4844  188.2406     13.7202     58.1303

 10 SALEPR      R/SE       D/F         DISTUF      CONS
  3LS             0.3242    0.0     -1674.305631911.1566
               4944.5820   78.7111     -8.8719     23.7551

 11 SALEPR      R/SE       D/F         DTUF50      CONS
  OLS             0.3145    0.0      -133.471727262.0131
               4979.8555   75.3273     -8.6792     31.2863

 12 SALEPR      R/SE       D/F         DISTMP      CONS
  3LS             0.0474    0.0        416.719017114.2887
               5870.5078    9.0575      3.0095     14.0851

 13 SALEPR      R/SE       D/F         DTMP50      CONS
  OLS             0.0201    0.0         16.149819255.5351
               5954.0352    4.3197      2.0784     25.3820

 14 SALEPR      R/SE       D/F         AREA W      CONS
  OLS             0.3945    0.0       7658.465517257.2447
               4680.3867  106.5370     10.3218     35.7482
```

```
15 SALEPR      R/SE       D/F       QUNBLA      QUNAUX      QULINX     AGEIMP      LOTSIZ      SITE 2     NEIQL2     NEIQL3     NEIQL4      DISTUF
 O_S          0.9474     1.9373     7.2215      3.8203     79.6342 -174.5704      0.1726   745.8689 1156.3830 4214.5664 7433.9777-1656.3591
           1379.8376   209.2257    13.2226      2.2037      6.2385    -7.2537      3.2102     2.9271     2.9703     6.6755     9.2133    -4.6853
```

```
                                 DTUFSQ     DISTMP     DTMPSQ    AREA W
                               126.4681  1133.5794   -64.5211  817.1272
                                 4.0099     3.5923    -3.9058    2.0312
16 SALEPR    R/SE       D/F       QUNAUX     QULINX     AGEIMP    LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.8864     0.0      3.4405   127.6478  -164.6440    0.1965   924.0331  2340.4917  7269.39731 3234.0702-1209.3295   81.9943
            2027.2817   98.1537    1.3509     7.0995    -4.6586    2.4902     2.4717     4.2046     8.4209    13.3007    -2.3232     1.7795

                                 DISTMP     DTMPSQ    AREA W
                              1626.6978   -92.1180  1267.1149
                                 3.5334    -3.8261     2.1516
17 SALEPR    R/SE       D/F       QUNBLA     QULINX     AGEIMP    LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9460     0.0      7.2015    83.5033  -166.7866    0.1659   771.6463  1180.1436  4505.1456  7759.9354-1709.4115   129.1297
            1397.7615  219.2095   13.0188     6.5197    -6.9163    3.0520     2.9926     2.9936     7.2031     9.6803    -4.7249     4.0447

                                 DISTMP     DTMPSQ    AREA W
                              1170.4921   -65.9195   929.2141
                                 3.6669    -3.9422     2.2987
18 SALEPR    R/SE       D/F       QUNBLA     QUNAUX     AGEIMP    LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9341     0.0      8.1907     5.3079  -201.0563    0.2779   666.7328   604.0924  3294.0463  6246.0550-1263.2552   109.5304
            1544.1914  177.5224   13.9785     2.7621    -7.5840    4.8650     2.3410     1.4238     4.7949     7.1182    -3.2280     3.1148

                                 DISTMP     DTMPSQ    AREA W
                              2160.8413  -118.4377  1271.7371
                                 7.1729    -7.5175     2.8723
19 SALEPR    R/SE       D/F       QUNBLA     QUNAUX     QULINX    LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9292     0.0      7.0980     1.9747    95.9687    0.1592  1145.2001  1114.4360  5154.5165  9298.4127-1024.3331    83.9859
            1599.9143  164.5822   11.2141     0.9931     6.5873    2.5566     3.9699     2.4691     7.1944    10.4850    -2.5550     2.3372

                                 DISTMP     DTMPSQ    AREA W
                                12.4816    -3.9458   375.0169
                                 0.0391    -0.2388     0.8134
20 SALEPR    R/SE       D/F       QUNBLA     QUNAUX     QULINX    AGEIMP     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9441     0.0      7.2807     3.5087    92.5016 -171.9331   638.8986  1313.0735  4543.7604  7854.4243-1810.4914   142.7109
            1422.2405  211.3347   12.9409     1.9666     7.4050   -6.9352     2.4537     3.2982     7.0763     9.5711    -4.9792     4.4475

                                 DISTMP     DTMPSQ    AREA W
                              1249.2023   -70.0479  1119.6329
                                 3.8659    -4.1365     2.7775
21 SALEPR    R/SE       D/F       QUNBLA     QUNAUX     QULINX    AGEIMP     LOTSIZ     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9447     0.0      7.3061     4.0533    77.7741 -189.7903     0.1520  1250.7205  4361.1429  7720.2920-1710.2483   131.4659
            1414.2310  213.8664   13.0704     2.2836     5.9520   -7.8804     2.7826     3.1453     5.7609     9.4048    -4.6965     4.0729

                                 DISTMP     DTMPSQ    AREA W
                              1280.0394   -72.6383   960.6760
                                 4.0085    -4.3520     2.3475
22 SALEPR    R/SE       D/F       QUNBLA     QUNAUX     QULINX    AGEIMP     LOTSIZ     SITE 2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 3_5           0.9446     0.0      7.5947     3.9630    71.0123 -173.5056     0.1926   808.5238  3102.6322  6133.9422-1781.8302   134.9743
            1415.3118  213.5222   13.9309     2.2295     5.5695   -7.0296     3.5206     3.1042     5.9498     8.8223    -4.9145     4.1895

                                 DISTMP     DTMPSQ    AREA W
                              1308.8701   -72.6840  1354.0832
                                 4.1164    -4.3503     3.6734
```

```
23 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL4     DISTUF     DTUFSQ
 0.5            0.9321     0.0         8.5555     6.2374    59.7190  -207.5440     0.2308   880.7797  -384.5737  4053.4483-1945.5040   143.1933
             1567.4990   171.9418     14.8176     3.2386     4.2355    -7.7565     3.8312     3.0524    -1.0799     5.6803    -4.9523     4.0090

                                     DISTMP     DTMPSQ     AREA W
                                   1414.4839   -78.5559  1667.6181
                                      3.9814    -4.2210     3.8471

24 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     DISTUF     DTUFSQ
 0.5            0.9179     0.0         9.9571     6.8374    51.8794  -245.2036     0.2529  1030.4624  -789.2739   563.7968-2220.9455   157.0142
             1722.9832   140.3210     17.3955     3.2154     3.3494    -8.6079     3.8192     3.2627    -1.9326     0.9186    -5.0725     4.0091

                                     DISTMP     DTMPSQ     AREA W
                                   1538.7318   -86.7547  1578.5254
                                      3.9436    -4.2514     3.2109

25 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DTUFSQ
 0.5            0.9400     0.0         6.9721     4.1733    68.7657  -146.5021     0.2044   796.2126  1355.8126  4563.6969  8072.9312   -17.9462
             1473.2424   196.1706     12.0137     2.2568     5.1309    -5.8867     3.5895     2.9292     3.2814     6.8178     9.5075    -2.5079

                                     DISTMP     DTMPSQ     AREA W
                                    437.1547   -32.3026   630.0402
                                      1.4709    -2.0142     1.4741

26 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 0.5            0.9421     0.0         6.9880     4.0956    75.2280  -156.6505     0.2071   801.1813  1298.1254  4415.5581  7774.0907  -272.9722
             1447.5134   203.6201     12.2667     2.2487     5.6387    -6.3146     3.7215     3.0016     3.1917     6.6979     9.2355    -3.4434

                                     DISTMP     DTMPSQ     AREA W
                                    519.2122   -36.4031   552.5422
                                      1.7941    -2.3200     1.3273

27 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 0.5            0.9432     0.0         7.4534     4.1509   103.5627  -132.2268     0.1946   891.0075  1417.9314  4517.0073  7837.9025-1064.6995
             1433.8665   207.7353     13.2256     2.3074     9.1522    -6.0644     3.5067     3.4081     3.5678     6.9470     9.4400    -3.2561

                                     DTUFSQ     DTMPSQ     AREA W
                                     71.4579    -5.7587   367.0642
                                      2.4940    -2.4056     0.9240

28 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 0.5            0.9423     0.0         7.4910     4.0804   105.7187  -127.0516     0.1944   912.9371  1409.3503  4528.6337  7894.3595-1033.2518
             1444.3408   204.5665     13.2094     2.2502     9.2840    -5.8454     3.4747     3.4721     3.5073     6.9088     9.4483    -3.2153

                                     DTUFSQ     DISTMP     AREA W
                                     74.1771   -86.8855   320.9986
                                      2.4815    -1.8862     0.8034

29 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 0.5            0.9463     0.0         7.3154     4.2656    84.3310  -167.1641     0.1991   805.9633  1511.7353  4620.7092  7770.5507-1594.5710
             1394.1621   220.4024     13.3045     2.4549     6.6485    -6.9549     3.7525     3.1659     4.3020     7.6367     9.7393    -4.4602

                                     DTUFSQ     DISTMP     DTMPSQ
                                    115.9604   933.9611   -53.9263
                                      3.6889     3.0826    -3.4051

30 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 0.5            0.9476     0.0         6.9892     4.0234    56.4777  -193.5660     0.1639   792.5458  1357.6252  4458.0014  7593.5595-1937.4115
             1377.4370   210.0642     12.0916     2.3163     2.4564    -6.7447     3.1425     3.0805     3.2116     6.7383     9.2299    -4.6155
```

```
                                 DTUFSQ    DISTMP    DTMPSQ    AREA #    CONS
                                 140.9769  964.7434  -56.2079  912.1947 4623.9557
                                   4.1845    2.8002   -3.1463    2.0224    1.2100

31 SALEPR   R/SE       D/F       QUNBLA    QUNAUX    QULINX    AGEIMP    LJTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTJF
 D_S          0.9474     0.0       7.1351    3.4663   87.3971 -196.5022    0.1720  679.7657 1110.1112 4173.8858 7305.9532-1824.3299
           1379.3647  195.4848    12.9302    1.9651    5.9639   -6.2353    3.2006    2.5944    2.8352    6.6015    9.9635   -4.7442

                                 DTUFSQ    DISTMP    DTMPSQ    AREA W    NE# 01
                                 138.3843 1169.0003  -65.8346  743.9520 -426.3510
                                   4.1417    3.6858   -3.9759    1.8241   -1.0774

32 SALEPR   R/SE       D/F       QUNBLA    QUNAUX    QULINX    AGEIMP    LJTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 J_S          0.9475     0.0       7.3375    3.6064   74.0750 -171.9674    0.1860  755.0500 1162.8687 4003.5338 7140.3936-1615.7394
           1378.2405  195.8199    13.2354    2.0712    5.4464   -7.1236    3.3881    2.9652    2.9901    5.1055    8.4618   -4.5155

                                 DTUFSQ    DISTMP    DTMPSQ    AREA W    TJPO 2
                                 123.4491 1175.1173  -66.6433 1033.5748 -399.6327
                                   3.9057    3.7050   -4.0149    2.3380   -1.1742
```

```
             18 AUGUST 1971
SUMMARY OF RESULTS

 33 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  0_S            0.9477      0.0        7.3833     3.1178    76.5723  -176.4368     0.1701   735.9948   987.8303  3758.9243  6853.6491-1725.3949
              1375.9897  196.4933      13.2443     1.7279     5.9234    -7.3397     3.1715     2.8953     2.4239     5.2704     7.5248    -4.8294

                                      DTUFSQ     DISTMP     DTMPSQ     AREA #     T3PD 3
                                    133.6550  1188.2285   -67.0493   958.0388   547.9341
                                      4.1908     3.7456    -4.0445     2.3122     1.3597

 34 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_S            0.9474      0.0        7.3982     3.1906    74.6940  -174.7384     0.1771   742.8018  1032.7334  3771.8457  6858.3319-1686.6984
              1379.5315  183.2830      13.2131     1.7565     5.4782    -7.1606     3.1605     2.9093     2.4533     5.2706     7.5101    -4.5752

                                      DTUFSQ     DISTMP     DTMPSQ     AREA #     T3PD 2     T3PD 3
                                    130.4390  1194.3790   -67.4290  1025.7856  -185.3711   411.9675
                                      3.9784     3.7517    -4.0515     2.3176    -0.4435     0.8123

 35 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_S            0.9472      0.0        7.1284     3.9527    80.3017  -172.3353     0.1653   714.6792  1171.0172  4143.5071  7315.2297-1609.5740
              1382.7314  194.4859      12.5871     2.2593     6.2558    -7.0720     3.0042     2.7492     2.9964     6.4505     8.8226    -4.3928

                                      DTUFSQ     DISTMP     DTMPSQ     AREA W     EXTRAF
                                    120.9197  1101.1245   -62.7436   750.8893     0.4890
                                      3.6895     3.4392    -3.7379     1.8041     0.6396

 36 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_S            0.9471      1.9150     7.2667     2.9940    81.6506  -193.0016     0.1753   668.1227  1021.7650  3721.1626  6705.5311-1784.7713
              1383.7969  161.9762      12.4899     1.6010     5.3300    -5.8132     3.0483     2.5224     2.4087     5.1256     7.1768    -4.2843

                                      DTUFSQ     DISTMP     DTMPSQ     AREA W     NEW 01     T3P3 2     TOPD 3     EXTRAF
                                    136.9263  1209.2315   -67.7028   940.9253  -391.9405  -252.0856   338.5709     0.2634
                                      3.7497     3.6942    -3.9671     2.0645    -0.9292    -0.5941     0.6590     0.3282

 37 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_5            0.9472      0.0        7.0523     3.1910    61.7026  -208.5099     0.1679   709.4007  1182.7550  3935.4829  6945.3511-2025.3039
              1382.5166  162.3468      11.4260     1.6991     2.5028    -5.7261     2.8996     2.6506     2.6190     5.2163     7.2201    -4.2459

                                      DTUFSQ     DISTMP     DTMPSQ     AREA W     NEW 01     T3PD 2     TOPD 3     EXTRAF     CONS
                                    149.8685  1050.9313   -59.8952   899.2076  -354.1893  -151.6566   402.1747     0.2971  4069.5312
                                      3.8848     2.9095    -3.2110     1.9670    -0.8373    -0.3487     0.7780     0.3703     1.0321

 38 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_S            0.9473      0.0        7.3063     3.8580    83.9995  -168.9900     0.1717   716.3734  1120.3047  4126.1345  7341.4182-1751.5073
              1380.1670  195.2462      13.2118     2.2243     6.2155    -6.8336     3.1934     2.7915     2.8643     6.4689     9.0354    -4.7859

                                      DTUFSQ     DISTMP     DTMPSQ     AREA W     DISTCB
                                    111.3519  1016.3678   -59.1002  -180.5610   269.0075
                                      3.1744     3.0133    -3.3937    -0.1657     0.9855

 39 SALEPR     R/SE       D/F         QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  3_5            0.9474      0.0        7.3594     3.7655    86.9983  -168.9858     0.1734   700.5658  1057.3161  4092.5595  7295.3102-1708.6728
              1379.8459  195.3416      13.0853     2.1710     5.9418    -6.8489     3.2256     2.7090     2.6361     6.3703     8.9203    -4.7729

                                      DTUFSQ     DISTMP     DTMPSQ     AREA W     DTCBSQ
                                    111.0712  1084.3628   -63.3675   -73.8886    18.5314
                                      3.1805     3.3973    -3.8271    -0.0773     1.0269
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40 SALEPR    R/SE       D/F          QUN3LA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NFIOL3     NFIQL4     DISTUF
 O_S           0.9470     0.0          7.3487     3.7911    86.3769 -168.7778     0.1729   703.5986 1072.4532 4098.0349 7304.6500-1723.0768
            1384.5317   181.8953      12.8647     2.1624     5.5505    -6.8010     3.1975     2.6990     2.5448     6.3417     9.8591    -4.5535
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                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    DISTC3    DTC8SQ
                                110.5782 1062.1707  -62.0473 -139.2003   80.5014   13.6803
                                  3.1345    2.9785   -3.1223   -0.1264    0.1211    0.3112

41 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9476      0.0    7.2162    3.5528   69.8374 -180.7091    0.1663  757.6699 1200.6673 4317.0604 7511.1760-1852.5274
              1376.4724 196.3487   13.2449    2.0407    4.7491   -7.3921    3.0897    2.9789    3.0803    6.8039    9.3076   -4.8499

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    DISTM5
                                150.7514 1450.6235  -77.6185 1586.1052  -90.7774
                                  4.1458    3.6757   -4.0448    2.2559   -1.3320

42 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9475      0.0    7.2022    3.6087   69.9356 -176.2545    0.1706  797.2780 1214.4749 4290.5714 7498.6469-1748.7229
              1378.0798 195.8678   13.1978    2.0727    4.5867   -7.3197    3.1756    3.0864    3.0979    6.7680    9.2831   -4.8282

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    DTM55Q
                                140.6373 1315.2337  -71.5695 1386.3515   -3.5989
                                  4.1625    3.7370   -4.0705    2.1854   -1.1595

43 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9473      0.0    7.2284    3.5435   71.1625 -183.4736    0.1637  723.5644 1183.0151 4324.0315 7510.3529-1927.5199
              1380.6621 182.9679   13.1917    2.0301    4.6296   -7.0222    2.9958    2.5996    2.9935    6.7899    9.2783   -4.3829

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    DISTM5    DTM55Q
                                155.5440 1515.9279  -80.6894 1639.2380 -152.0394    2.9450
                                  3.9194    3.3720   -3.7193    2.2572   -0.7196    0.3064

44 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9505      0.0    7.0027    2.4337   97.0704 -225.2625    0.1424  597.4574  869.1988 3953.6718 7085.4247-2367.1125
              1337.6423 208.4948   13.1219    1.4040    7.2035   -8.0408    2.6901    2.3788    2.2430    6.4055    8.9770   -5.8309

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    F235 0
                                182.2210 1222.8755  -66.4582  477.8481 1411.9780
                                  5.2047    3.9317   -4.1471    1.1841    3.2685

45 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9480      0.0    7.2318    3.5371   71.3726 -174.4888    0.2008  802.9925 1083.3628 4178.8484 7351.6512-1849.5599
              1372.1226 197.6583   13.3149    2.1377    5.2346   -7.2911    3.5782    3.1400    2.7955    6.6522    9.1449   -4.3907

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    SOIL 0
                                149.1839 1263.8227  -74.3049  358.1011 1046.6357
                                  4.3565    3.9362   -4.2553    0.7353    1.6523

46 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9470      0.0    7.3032    3.7197   84.9034 -169.2396    0.1726  735.2884 1120.0435 4180.5695 7380.0950-1615.2329
              1384.4917 193.9668   12.0131    2.1022    3.9904   -5.7097    3.2006    2.8507    2.7464    6.5027    8.9129   -4.1261

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    SHAPEF
                                123.9878 1170.6390  -66.3436  811.5331  -10.1823
                                  3.7985    3.4591   -3.7725    2.0085   -0.3101

47 SALEPR     R/SE       D/F      QUNBLA    QUNAUX    QULINX    AGEIMP    L3TSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF
 0_5             0.9476      0.0    7.2015    4.0592   54.6135 -194.4170    0.1684  796.5893 1375.5827 4490.8743 7719.7455-1943.0660
              1376.3113 196.3969   13.2146    2.3344    2.3756   -6.8442    3.1362    3.0983    3.2519    6.7604    9.2653   -4.7035

                                  DTUFSQ    DISTMP    DTMPSQ    AREA W    SIZEFA
                                141.0132  952.1923  -55.5672  808.4544   46.7525
                                  4.2258    2.7690   -3.1139    2.0145    1.3067
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48 SALEPR   R/SF        D/F         OUNBLA     OUNAUX     OULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9497     0.0         8.4090     3.2413    58.3570 -173.5536      0.1565   790.6085  1495.7579  4826.0823  7739.0557-2029.5074
            1348.8113   192.1501     12.0185     1.8721     2.5850    -6.0026      2.9632     3.1376     3.5871     7.2792     9.4870    -4.9952

                                    DTUFSQ     DISTMP     DTMPSQ     AREA W      SHAPEF     SIZEFA
                                    147.9151   961.4577   -55.9174   694.3091  -158.3998    192.9585
                                      4.5089     2.8518    -3.1973     1.7550     -2.6714     2.9687

49 SALEPR   R/SE        D/F         QUNBLA     QUNAUX     OULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9472     0.0         7.1266     3.8703    72.8750 -175.1687      0.1696   785.2957  1214.1700  4245.9445  7480.6752  -908.2477
            1382.2507   194.6282     12.6138     2.1998     4.4838    -7.2609      3.1404     2.9987     3.0406     6.6952     9.2212    -0.7695

                                    QTUFSD     DISTMP     DTMPSQ     AREA W      QTJFCU
                                    -26.3497  1084.2882   -61.7131   843.6627     9.0601
                                     -0.1151     3.3418    -3.6164     2.0836     0.6738

50 SALEPR   R/SE        D/F         QUNBLA     OUNAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9475     0.0         7.0724     3.8956    64.5029 -131.5577      0.1963   825.7202  1280.4078  4310.3446  7539.4793-1809.9582
            1377.9194   195.9157     12.6222     2.2486     3.5388    -7.3282      3.4176     3.1327     3.1759     6.7789     9.2982    -4.8135

                                    DTUFSQ     DISTMP     DTMPSQ     AREA W      DTMPCU
                                    132.2328  2135.0445  -198.9380   854.7013     5.3187
                                      4.1473     2.3256    -1.7017     2.1207     1.1614

51 SALEPR   R/SE        D/F         QUNBLA     OUNAUX     OULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9472     0.0         7.0117     3.8904    60.5002 -181.5324      0.1925   849.6469  1314.9954  4327.0929  7567.0651-1234.1739
            1381.6306   182.6986     12.1959     2.2396     3.0289    -7.3070      3.3131     3.1627     3.2056     6.7775     9.2855    -1.0127

                                    DTUFSQ     DISTMP     QTMPSQ     AREA W      DTJFCU     DTMPCU
                                     17.7831  2029.2935  -187.5860   871.9182     6.7518     4.9524
                                      0.0764     2.1477    -1.5707     2.1497     0.4967     1.0649

52 SALEPR   R/SE        D/F         OUNIMP     OULINX     AGEIMP     LOTSIZ      SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF     DTUFSQ
 DLS           0.9465     0.0         6.9278    78.5321  -180.5037     0.1790    732.4421  1187.7949  4108.1305  7408.3890-1618.8356   122.3323
            1391.8096   221.1872     13.1240     6.1057    -7.5008     3.3084      2.8508     3.0275     6.4770     9.1039    -4.5245     3.8561

                                    DISTMP     DTMPSQ     AREA W
                                   1124.5690   -64.5626   744.7962
                                      3.5335    -3.8747     1.8439

53 SALEPR   R/SF        D/F         EXOBLA     QUNAUX     OULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9402     0.0      1264.7559     4.2453   100.0608 -160.7874      0.1817   726.4426  1498.9698  4830.2106  7132.4706-1256.5375
            1470.5706   182.9313     11.6658     2.2964     7.5499    -6.2713      3.1725     2.6735     3.6544     7.3165     8.0019    -3.3311

                                    DTUFSQ     DISTMP     DTMPSQ     AREA W
                                     95.8713  1246.4521   -69.7487  1004.6923
                                      2.8667     3.7149    -3.9699     2.3485

54 SALEPR   R/SE        D/F         QUNBLA     EXQAUX     QULINX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9460     0.0         7.2511    11.3256    92.1312 -168.5590      0.1618   756.9423  1169.7732  4454.9598  7714.0772-1665.9283
            1397.1023   203.8253     13.0677     1.0571     6.3828    -6.9762      2.9694     2.9327     2.9678     7.1057     9.5947    -4.6161

                                    DTUFSQ     DISTMP     DTMPSD     AREA W
                                    127.2923  1159.5469   -65.5370   934.9266
                                      3.9831     3.6324    -3.9202     2.3137

55 SALEPR   R/SE        D/F         OUNBLA     QUNAUX     EXQLIX     AGEIMP      LOTSIZ     SITE 2     NEIOL2     NEIOL3     NEIOL4     DISTUF
 D_S           0.9476     0.0         7.2352     3.7379  2834.4492 -172.5442      0.1727   732.0172  1127.8015  4195.2253  7402.4094-1635.3225
            1377.1257   210.0926     13.2966     2.1583     6.2974    -7.1678      3.2213     2.8796     2.9112     6.6681     9.2093    -4.6224
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                                 DTUFSQ     DISTMP     DTMPSQ     AREA W
                               125.1139  1155.3194   -65.5176   819.3703
                                 3.9771     3.6967    -4.0019     2.0416

56 SALEPR    R/SE        D/F     QUNBLA     QUNAUX     QULINK     EXPAGE     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 OL5           0.9436      0.0     7.1765     3.9945    49.6417  3329.4348     0.1799   920.9195  1415.7107  4649.0147  8048.8401-1251.8177
            1428.8535 194.3997    12.6924     2.2131     3.3150     6.2488     3.2279     3.5404     3.4872     7.2083     9.8533    -3.5702

                                 DTUFSQ     DISTMP     DTMPSQ     AREA W
                                96.1400   817.4686   -48.8856   787.6149
                                 2.9903     2.6145    -2.9775     1.8886

57 SALEPR    R/SE        D/F     QUNBLA     QUNAUX     QULINX     AGEIMP     EXPLOT     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
 D_5           0.9473      0.0     7.1675     3.8564    73.2575  -178.5920  1792.2327   750.2548  1213.5383  4283.6192  7530.2917-1734.2631
            1380.9529 208.8707    13.0926     2.2217     5.4026    -7.3911     3.1746     2.9393     3.1291     6.8120     9.3738    -4.9009

                                 DTUFSQ     DISTMP     DTMPSQ     AREA W
                               130.5415  1081.1512   -62.0349   857.5920
                                 4.1586     3.3979    -3.7291     2.1439
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             18 AUGUST 1971
SUMMARY OF RESULTS

 58 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     EXDTUF
  OLS           0.9423     0.0      6.5475     4.4249    38.3397  -182.0106     0.1992   864.4977  1614.8076  4831.6995  8267.7290  6997.0319
             1445.0967  204.3404   11.4639     2.4391     3.0340    -6.5327     3.6046     3.2263     3.9641     7.4675    10.2494     3.5154

                                  DISTMP     DTMPSQ     AREA W
                                  261.4242   -23.6235   585.6522
                                    0.8732    -1.4714     1.4203

 59 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF
  OLS           0.9428     0.0      7.4893     4.1324   106.5240  -128.7031     0.1940   893.1598  1393.8331  4498.3853  7835.2755-1052.1251
             1438.1260  206.4382   13.2673     2.2743     9.3832    -5.9334     3.4856     3.4052     3.5035     6.8998     9.4048    -3.1427

                                  DTUFSQ     EXDTMP     AREA W
                                   71.5394  -371.5939   350.3332
                                    2.4406    -2.1935     0.8799

 60 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     QULINX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     EXDTUF
  OLS           0.9425     0.0      6.7882     4.4537    52.4275  -171.4700     0.2032   904.2897  1649.9766  4936.0454  8227.7937  7352.0299
             1442.2607  222.2061   11.8468     2.4592     5.0258    -6.4503     3.6916     3.4344     4.1516     7.5400    10.2217     3.8527

                                  EXDTMP     AREA W
                                 -682.7926   422.8771
                                   -4.4593     1.0884

 61 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
  OLS           0.9479     0.0      9.3260     4.1731  -216.4796     0.1842   525.3515  1164.7458  4403.9309  6908.1541-2421.3509   199.3324
             1372.4868  211.5872   16.9490     2.4302    -9.1396     3.4872     2.0675     3.0084     6.9375     8.7806    -6.1749     5.6255

                                  DISTMP     DTMPSQ     AREA W     PLUMBG
                                 1589.1690   -88.9099  1167.2401   517.0729
                                    5.6295    -6.0298     2.9636     6.3931

 62 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
  OLS           0.9370     0.0      7.9824     4.9529  -172.6457     0.2313   574.4147   495.2350  3090.8626  6146.0116-1164.0995   102.3743
             1509.2432  173.1382   13.8256     2.6307    -6.2164     3.9766     2.0496     1.1892     4.5775     7.1603    -3.0309     2.9707

                                  DISTMP     DTMPSQ     AREA W     HTGAIR
                                 2057.4674  -112.4370  1066.4099   138.9727
                                    6.9351    -7.2341     2.4307     2.8414

 63 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
  OLS           0.9386     0.0      7.6275     5.5496  -207.0513     0.2935   618.3100   790.6828  3526.8610  6676.8828-1505.8953   133.7812
             1490.7703  177.7210   12.9562     2.9893    -8.0715     5.3053     2.2458     1.9138     5.2905     7.7978    -4.1112     3.8590

                                  DISTMP     DTMPSQ     AREA W     EXTWAL
                                 1971.9833  -109.0368  1160.8654   144.4245
                                    6.6638    -7.0567     2.7082     3.4539

 64 SALEPR    R/SE      D/F       QUNBLA     QUNAUX     AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
  OLS           0.9433     0.0      7.0615     4.4352  -210.8753     0.1899   694.4734  1282.2285  4198.9183  7049.5676-1950.1213   145.2251
             1432.5425  193.3449   12.0070     2.4767    -8.5474     3.4049     2.6279     3.0819     6.3406     8.4972    -5.0275     4.3599

                                  DISTMP     DTMPSQ     AREA W     CARMIL
                                 1190.2722   -67.5756   968.3184  1309.3044
                                    3.5046    -3.8021     2.3325     5.0292
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65 SALEPR     R/SE       D/F         QUNBLA     QUNAUX    AGEIMP     LOTSIZ     SITE 2     NEIQL2     NEIQL3     NEIQL4     DISTUF     DTUFSQ
 J.S            0.9346     0.0         8.1591     5.1137 -178.6186     0.2611   740.9179   574.4290  3314.4500  6278.3702-1045.9937    98.5235
             1537.9673  166.3376      13.9718     2.6557    -5.8874     4.5052     2.5733     1.3579     4.8432     7.1818    -2.5155     2.3472
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                                DISTMP    DTMPSQ    AREA W    FLDFIN
                             1953.4310 -106.7220 1191.0135   64.1771
                                5.9139   -6.0899    2.6910    1.5015

66 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9350       0.0    7.8298    4.7072 -231.7928    0.2506  710.2861  843.9869 3687.2576 6745.6986-1586.0973  132.0172
           1533.8149  167.2971   12.6726    2.4268   -7.3107    4.2587    2.5010    1.9035    5.1298    7.3512   -3.6826    3.5449

                                DISTMP    DTMPSQ    AREA W    INTFIN
                             2013.8910 -110.2619 1207.3632  170.9349
                                6.4774   -6.7484    2.7357    1.7405

67 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9494       0.0    9.1169    3.9634 -194.6478    0.1542  463.5955 1057.0284 4199.8324 6802.1127-2292.5475  180.1908
           1352.6208  203.6855   16.5871    2.3386   -7.7398    2.8746    1.8410    2.7503    6.6485    8.7578   -5.8714    5.3951

                                DISTMP    DTMPSQ    AREA W    PLUMBG    HTGAIR
                             1539.8495  -85.8715 1019.8139  492.2647  103.1767
                                5.5190   -5.8856    2.5932    6.1216    2.3331

68 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9503       0.0    8.6913    4.1969 -194.9593    0.1705  449.5174 1090.4058 4194.7818 6953.1082-2344.2793  184.0751
           1341.0217  194.4960   14.7412    2.4911   -7.8195    3.1648    1.7997    2.8586    6.6979    8.9814   -6.0495    5.5484

                                DISTMP    DTMPSQ    AREA W    PLUMBG    HTGAIR    EXTWAL
                             1497.7035  -83.8530  964.3681  436.9247  108.9119   75.7564
                                5.3969   -5.7813    2.4664    5.1445    2.4782    1.8902

69 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9509       0.0    8.1533    4.0414 -197.0867    0.1528  489.0188 1248.1536 4354.4851 7122.4850-2402.4882  193.7323
           1333.2063  185.3679   12.1423    2.4090   -7.9400    2.7970    1.9602    3.1906    6.9099    9.1722   -6.2007    5.5705

                                DISTMP    DTMPSQ    AREA W    PLUMBG    HTGAIR    EXTWAL    CABMIL
                             1242.5445  -70.4044  895.0934  358.8699  102.7420   64.5665  486.5566
                                3.9244   -4.2459    2.2596    3.7040    2.3428    1.5973    1.6427

70 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9508       0.0    8.1824    3.9370 -181.6882    0.1433  524.0698 1189.1846 4305.7877 7087.9364-2233.8319  159.1642
           1334.0742  174.8870   12.1641    2.3399   -6.0572    2.5756    2.0750    2.9976    6.8040    9.1110   -5.2042    4.6170

                                DISTMP    DTMPSQ    AREA W    PLUMBG    HTGAIR    EXTWAL    CABMIL    FLOFIN
                             1164.2215  -65.7551  839.9192  358.8426  113.1419   61.0782  429.6061   36.3246
                                3.5477   -3.7998    2.1261    3.7013    2.4961    1.5033    1.4186    0.9157

71 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9513       0.0    8.3851    4.3965 -154.4371    0.1580  495.5182 1101.7677 4142.0537 6788.8840-2076.5890  155.6472
           1327.2607  167.5190   12.3043    2.5874   -4.4776    2.8149    1.9670    2.7643    5.4911    8.5190   -4.7352    4.1564

                                DISTMP    DTMPSQ    AREA W    PLUMBG    HTGAIR    EXTWAL    CABMIL    FLOFIN    INTFIN
                             1110.5449  -53.4558  859.4809  378.0757   95.3575   72.0810  637.3183   43.5849 -170.9098
                                3.3831   -3.6632    2.1857    3.8887    2.0795    1.7572    1.9379    1.0969   -1.5758

72 SALEPR   R/SE      D/F       QUNBLA    QUNAUX    AGEIMP    LOTSIZ    SITE 2    NEIQL2    NEIQL3    NEIQL4    DISTUF    DTUFSQ
 OLS          0.9443       0.0    8.3328    4.3378 -165.4401    0.1726  475.4475  665.4901 3433.6650 6360.4109-1574.7874  130.5799
           1419.7434  197.0395   15.4487    2.4423   -6.5464    3.0776    1.7989    1.7053    5.4316    7.8811   -4.3202    4.0071

                                DISTMP    DTMPSQ    AREA W    87
                             1783.5733  -97.9806  929.1229  203.9908
                                6.2393   -6.5389    2.2546    5.3349
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73 SALEPR     R/SE        D/F         QUNBLA      QUNAUX      AGEIMP      LOTSIZ      SITE 2      NEIQL2      NEIQL3      NEIQL4      DISTUF      DTUFSQ
D_5               0.9469      0.0         7.6972      4.8331 -180.5523      0.2151    473.6089    849.5084   3647.8487   6792.0071-1864.0417    151.2440
              1385.7222   207.3624     14.4686      2.7998     -7.5149      4.1146      1.8270      2.2189      5.8912      8.5705     -5.1111      4.6843

                                      DISTMP      DTMPSQ      AREA W      872
                                    1674.4442   -92.9590    894.7053    154.0648
                                       5.9414     -6.3062      2.2252      6.1067

74 SALEPR     R/SE        D/F         QUNBLA      QUNAUX      AGEIMP      LOTSIZ      SITE 2      NEIQL2      NEIQL3      NEIQL4      DISTUF      DTUFSQ
D_5               0.9479      0.0         7.5730      4.7385 -181.9737      0.2057    476.5247    924.8328   3747.9960   6877.6452-1935.4933    154.8131
              1373.4478   211.2764     14.2860      2.7686     -7.6561      3.9533      1.8682      2.4293      6.0927      8.7422     -5.3217      4.8269

                                      DISTMP      DTMPSQ      AREA W      8723
                                    1568.4957   -87.4068    864.6768    151.9466
                                       5.5307     -5.8921      2.1674      6.3744

75 SALEPR     R/SE        D/F         QUNBLA      QUNAUX      AGEIMP      LOTSIZ      SITE 2      NEIQL2      NEIQL3      NEIQL4      DISTUF      DTUFSQ
D_5               0.9469      0.0         7.6378      4.4863 -143.4143      0.1887    655.1045    804.0727   3694.9969   6811.3272-1389.0916    135.9751
              1386.5154   207.1129     14.3056      2.5922     -5.5984      3.5378      2.5617      2.1029      5.9564      8.5857     -3.9464      3.3558

                                      DISTMP      DTMPSQ      AREA W      87234
                                    1295.9560   -71.5226    794.2098    121.2984
                                       4.2418     -4.4400      1.9600      6.0896

76 SALEPR     R/SE        D/F         QUNBLA      QUNAUX      AGEIMP      LOTSIZ      SITE 2      NEIQL2      NEIQL3      NEIQL4      DISTUF      DTUFSQ
D_5               0.9460      0.0         7.4858      4.2206 -169.8355      0.1833    683.5304    926.6749   3985.5413   7047.5389-1572.5296    120.3365
              1397.8892   203.5840     13.7599      2.4124     -6.9071      3.3832      2.6510      2.3881      6.1678      8.7424     -4.3899      3.7739

                                      DISTMP      DTMPSQ      AREA W      872345
                                    1316.3686   -72.5033    815.8441    105.6923
                                       4.2636     -4.4504      1.9979      5.8338
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BIOGRAPHICAL SKETCH

Ronald Olan Boatright was born May 30, 1938, at Live Oak, Florida. From 1958 to 1961, he was a member of the United States Army Security Agency in Germany. He graduated in 1964 from the University of Florida with a B.S.B.A. in Economics degree awarded with high honors.

A Master of Business Administration degree, with a major in Marketing, was received in 1965 at the University of Florida. Following graduation, he was employed by the International Division of The Procter and Gamble Company and located in Germany. He held the positions of staff assistant, assistant brand manager, and brand manager of nationally distributed products during the three years with the firm.

He enrolled in the doctoral program at the University of Florida in 1968, with fields in Real Estate and Urban Land Studies, Economic Theory, Public Finance, and Management. From 1968 to 1971, he was a full-time graduate teaching associate at the University of Florida while pursuing the doctoral study. In 1971, he was appointed Assistant Professor of Real Estate at Memphis State University.

Ronald Olan Boatright is married to the former Ingrid Maria Kuehne, and is the father of two children.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Clayton Curtis

Clayton C. Curtis, Chairman
Associate Professor of Real Estate and
Urban Land Studies

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Irving J. Goffman
Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Associate Professor of Management and
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This dissertation was submitted to the Department of Real Estate and Urban Land Studies in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December, 1971

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